



POST-AUTOMATION

Report from an international workshop

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Post-automation: report from an international workshop

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patterns amidst these diverse alternatives that could inform a more general conceptualisation of technology that enhances rather than excludes human creativity, which opens up democratic participation in technology, and in which care for more environmentally sustainable and socially equitable developments are basic design features? We wanted to know, **what are the contours of post-automation societies, in which citizens play a more constructive rather than adaptive role in the development of its technology?**

Workshop participants were invited to bring examples whose open-ended possibilities appeared suggestive for a post-automation proposition (see table 1). We shared and discussed analysis from the worlds of labour relations and citizen rights, platform co-operatives and peer production, citizen sensing and data sovereignty, decentralised manufacture and commons-based economy, and grassroots digital urbanism. Each example highlighted the social shaping of digital technologies, and drew analytical attention to strategies for building technologies more democratically. Where automation theory presumes social adaptation to technology, post-automation insists upon its social construction.

What is gained by bringing apparently disparate initiatives into dialogue? What we learnt was:

- Social adaptation to automation misrepresents the nature of technology, appears inadequate to the task of sustainable human flourishing, and ignores a rich variety of more promising sociotechnical developments (section 3);
- Post-automation draws attention to the realities of more constructive, sociotechnical approaches to technology, and it usefully highlights the plurality of adaptable sociotechnical alternatives in circulation (section 4);
- Considering that plurality as experimental prototypes in future possibilities is helpful for public debates, because it enables identification of cross-cutting themes that can inform strategic activism, business strategy and public policy (section 5 and 6);
- The cross-cutting themes need much greater attention and work, especially in the formation of new institutions for post-automation (section 7).

3: The social adaptation challenge in automation theory

The observation that technologies are socially shaped, and that the ‘sociotechnical’ results feedback to shape societies, in turn, is nothing new (Matthewman, 2011). Yet the point appears neglected in public and policy discourse towards automation projects like Industry 4.0 and the Smart City. Automation theory takes as axiomatic imperatives for technology development linked to labour productivity, managerial control, and capital accumulation. These axioms have a very strong hold in societies, politically and economically. But its grip is troubled by intersecting crises in ecology, economy, and society. These axioms feed anxieties about automation, and prompt debates about alternative approaches to digital technology.

Automation theory usually defines technology in functional terms:

“[Automation] is a concept through which a machine-system is caused to operate with maximum efficiency by means of adequate measurement, observation, and control of its behaviour. It involves a detailed and continuous knowledge of the functioning of the system, so that the best corrective actions can be applied immediately they become necessary. Automation in this true sense is brought to full fruition only through a thorough exploitation of its three major elements, communication, computation, and control – the three ‘C’s.’” (Bagrit, 1966: 14)

Engineer Leon Bagrit gave this definition in 1964. Its functional orientation, based in the affordances of new technologies, still serves for dominant approaches to automation today. Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, promotes a new, expanded wave of automation in similar terms:

“[Industry 4.0] creates a world in which physical and virtual systems of manufacturing globally cooperate with each other in a flexible way. This enables the absolute customization of products and the creation of new operating models. The fourth industrial revolution, however, is not only about smart and connected machines and systems. Its scope is much wider. Occurring simultaneously are waves of further breakthroughs in areas ranging from gene sequencing to nanotechnology, from renewables to quantum computing. It is the fusion of these technologies and their interaction across physical, digital and biological domains that make the fourth industrial revolution fundamentally different from previous revolutions.” (Schwab, 2017: 7-8)

Wednesday 11th September 2019	
<i>Activity:</i>	
What does post-automation mean for you right now?	Adrian Smith (University of Sussex) and Mariano Fressoli (Fundación Cenit)
<i>Papers:</i>	
Expanding Industry 4.0: Social science approaches to studies of technology change	Christopher Foster and Claire Hoolohan (University of Manchester)
Automation now and then: Automation fevers, anxieties and utopias	Ben Roberts (University of Sussex) and Caroline Bassett (University of Cambridge)
Meet Your personal cobot: Will it change you? Can you resist it?	Tudor B. Ionescu (Vienna Technical University)
Thursday 12th September 2019	
<i>Papers:</i>	
Facing the transition: Visions around Industry 4.0 from makers and manufacturers	Raúl Tabarés Gutiérrez (Fundación Tecnalia Research & Innovation)
Fairwork and the gig economy: Seeking decent work standards for South African platform workers	Richard Heeks (University of Manchester), Mark Graham (University of Oxford), Paul Mungai (Fairwork), Jean-Paul Van Belle (University of Cape Town) & Jamie Woodcock (University of Oxford)
<i>Activity:</i>	
Post automation possibilities	Facilitated by Ann Light (University of Sussex and University of Malmö)
<i>Papers:</i>	
Post-Automation: an alternative to post-conflict in Colombia	Belén Albornoz (FLACSO-Quito), Mónica Bustamante and Javier Jimenez (Universidad de Los Andes)
The emergence of digitalised small-scale production networks in the global South: a case study of Vietnam	Ryo Zeo-Sindy (University of Manchester)
Are makers the new 'alternative'? Evidence from Africa's makerspaces	Erika Kraemer-Mbulaa (University of Johannesburg) and Elvis Korku Avenyoa (University of Oxford)
<i>Activity:</i>	
Post-automation challenges	Facilitated by Ed Steinmueller (University of Sussex)
Friday 13th September 2019	
<i>Papers:</i>	
Scope of young entrepreneurs' contribution to post-automation in Mexico	Carmen Bueno, Patricia Alvarado and Arturo Zepeda (Iberoamericana University)
How can post-automation developments such as new sensing technologies and big open data come together to foster more democratic and sustainable local and at-a-scale environmental monitoring? The case of the GROW Citizens' Observatory	Raquel Ajates Gonzalez (University of Dundee)
Digital technologies and community developments in post-automated cities	Adrian Smith (University of Sussex)
Governing robotics through ethical standards	Cian O'Donovan (University College London)
Capturing value in open innovation: the case of Sensorica	Alex Pazaitis (Talinn University of Technology)
<i>Activity:</i>	
Post-automation reflections	Facilitated by Adrian Smith (University of Sussex) and Mariano Fressoli (Fundación Cenit)

Table 1: the SPRU post-automation workshop

Industry 4.0 envisages global ‘cyber-physical systems’ for manufacturing, logistics markets, and consumption of goods and services, and whose so-called revolutionary advances will be made through the seamless deployment of cloud computing, the Internet of Things, robotics, 3D printing, Big Data, machine learning, genetics, material science and other technologies of communication, computation and control (Schwab, 2017). Advocates, include leading businesses, management consultancies, and, increasingly, national governments, whose active investment in the technologies is informed by this vision.

Compared to earlier waves of automation, the systems today in which automation operates have become more complex, the kinds of feedback and interactions more sophisticated, and the scope of applications more ambitious. Automation now spills beyond individual workplaces and households, and into the integration of entire systems of production and consumption; feedback is informed by increasingly sophisticated machine learning; and applications extend beyond Industry 4.0 to include urban development (Smart Cities), food, health, policing, social security, and even public affairs.

Not everyone is so sanguine about the consequences of framing technology development in this way. Waves of enthusiasm for automation possibilities have always been accompanied by undertows of anxiety (Bassett and Roberts, 2019). Whether it is worry about the future of work, the kinds of society required to make cyber-physical systems operational, technological sovereignty and citizen rights, or the ecological consequences of endless productivity growth, there is plenty to question about adapting to automation.

Common across many of these anxieties one finds a troubling sense of losing control and being controlled. Leon Bagrit noted as much in 1964:

“For many people, automation is a terrifying word. It conjures up visions of tyrannical machines reducing man to the status of a mere pusher of buttons or watcher of dials, and abolishing the need for human thought and judgement. I can sympathize with these fears, but I am sure they are unjustified ... Automation is not a devil, a Frankenstein. It is no more than a tool, but a tool of such immense possibilities that no one can yet see the full extent of what it might achieve for mankind [sic].” (Bagrit, 1966: 11).

Note again the functional representation. Automation is simply a tool. What matters, under this view, is to what purpose the tool is put, and whose hand is upon the controls. Ethical frameworks are often proposed for adapting to automation, so that the risks are better acknowledged and managed, whilst encouraging any benefits to be distributed more fairly.

The promotion of technological revolutions tends to elide a particular vision of the future with the interests seeking to advance the technology in that form. Ethical frameworks try to contain rather than transform the social relations promoting the technology, and so the fundamentals of automation theory remain largely unchanged: boosting labour productivity, enhancing managerial control, and advancing capital accumulation. Codes of practice ask, how to achieve this ethically, rather than questioning whether these goals are worth achieving at all (Pasquale, 2019).

The same year Leon Bagrit elaborated his *Age of Automation*, an Ad Hoc Committee of public intellectuals in the USA sought more radical social control over automation. State coordination and planning were vital to translating labour productivity gains into reduced work for all, backed by a universal basic income for citizens (Ad Hoc Committee, 1964). Theorists of different stripes, left and right, welcome basic income because they wish to advance automation for society’s needs as widely and profoundly as possible. More recently, accelerationist ideas for Fully Automated Luxury Communism (FALC) propose a similar social adaptation to this form of technology (Srniczek and Williams, 2015; Bastani, 2019).

Critical theorists have long argued that technologies are never neutral tools: they embody and reinforce interplays of power and social values in their design, development, use, disposal. And in their controversies, resistance, and subversions technologies reveal deeper conflicts in societies and contestations over their material cultures (Matthewman, 2011). Under this critical view, capital-intensive technologies privilege and reinforce the controlling interests of capital first, over and above any wider public interest, which is defined and circumscribed by the imperative of the first goal (Feenberg, 2002; Dagnino, 2009). Whilst the full development productive forces is important in some Marxist traditions, the evidence for broad technological trajectories produced under one set of relations, such as capitalism, automatically becoming appropriate to other relations, such as socialism, is patchy. Adaptive approaches reproduce the functional terms in the inevitable progression of automation, rather than engaging in technology itself as a site of struggle in its sociotechnical configuration of society.

Indeed, if we recall some of the difficulties in bringing about the workerless, flexible factories envisaged in earlier waves of automation, including their contestation by skilled workers, creative consumers, and lively environments (Smith, 2014a), then we see how the installation of these technologies requires considerable human and social work (Sayer, 1989). None of that denies the historical impact of automation. Rather, experience questions the facility with which automation is brought about. Bringing to the fore the political and economic strategies required to discipline people, organisations, and environments into conformity with systems moderates and grounds some of the excitement (and anxiety) in the visions.

The universalising talk of technological frontiers in automation theory is rarely experienced universally. The historical, social and geographical distribution and clustering of technological capabilities, and their consequences for employment, under-employment and unemployment, or for patterns of ecological exploitation, or forms of consumption and economic growth, will be shaped by the particular and differentiated social contexts in which struggles over automation take place, and over which aggregate studies have limited conception. The cyber-physical systems designed by engineers and promoted by management consultants might find themselves confounded, contorted and changed by failures in their presumed system-alignments to connect with people and their social situations. The human components and specific situations may resist falling into line and conforming with the assumptions coded into those systems. Automation can be very messy.

Aaron Benanav summarises this adaptive challenge in automation theory thus:

“[Automation theorists] tend to begin from the wrong transitional questions: starting from the assumption that full automation will be achieved, they go on to ask how we would need to transform society in order to save humanity from the mass joblessness it would cause and create a world of generalized human dignity. But it is possible to reverse this thought experiment, so that instead of presupposing a fully automated economy and imagining the possibilities for a better and freer world created out of it, we begin from a world of generalized human dignity and then consider the implications for technical change in working to realize that world.” (Benanav, 2019: 135-6).

Benanav continues, *“If full automation can appear as both a dream and a nightmare, that is because it has no innate association with human dignity, and will not generate a post-scarcity world by itself”* (Benanav, 2019: 142). We add to this concern, a lack of attention and care in automation theory towards the geographies and social worlds in which technologies are unavoidably situated, out of which they develop, and which they help cement into place. Generalized human dignity might require more convivial technologies (Illich, 1973), whose creative adaptability might itself be a condition for human dignity.

4: Post-automation: a socially constructive approach to technology?

Post-automation is being practised already in diverse places and spaces: hackerspaces, makerspaces and fablabs; citizen monitoring platforms and open science projects; open hardware platforms and grassroots innovation initiatives; new crafting practices; repair, repurposing and upcycling workshops; libraries and educational institutes opening technology to popular experimentation; citizen laboratories and DIY urbanism; workplace struggles for human-centred, democratic technology; platform co-operative enterprises; technopolitical platforms for citizen participation and direct democracy. These spaces reconfigure digital technology in pursuit of social relations absent in automation theory:

- Permitting democratic deliberation over the technology itself (cf controlling it)
- Enabling creative human livelihoods (cf labour productivity per se)
- Adaptable to diverse social and geographic situation (cf universal technological frontiers)
- Caring about sustainability and material sufficiency (cf rapid disruptions)
- Seeing technology as productive commons (cf a device for rent extraction)

Post-automation spaces work through networks that cut across conventional categories and sectors; appearing simultaneously to constitute a movement and infrastructure for social relations with technology radically different to the depopulated visions of Industry 4.0 or the urban operating systems of the Smart City.

What we find in these spaces are groups of people appropriating and hacking digital technologies for design, prototyping, and manufacture that were implicated initially in successive waves of automation - code, sensors, actuators, computer numerically controlled machine tools, design software, microelectronics, internet platforms, 3D scanners/printers, video, etc., but which are now being repurposed. In place of relations axiomatic to automation - enhanced labour productivity, managerial control, economic growth - people are subverting

these technologies and adapting them to social visions for human creativity, dignified work, and sustainable development.

It should be clear by now that post-automation is not proposed as a successive phase after automation has become all-pervasive (Smith, 2014b). Rather, post-automation is about the subversion of technologies that appear foundational to automation theory, and appropriating them for different social purposes, on less functionalist terms. Post-automation looks to a more open horizon based in democratic and sustainable relations with technology, and that thereby develops socially useful purposes in human-centred not human-excluding ways. The 'bland ambition' behind automation technologies is unsettled by more imaginative explorations (Bassett, Kember and O'Riordan, 2020).

Thus, post-automation proposes going beyond automation theory in the following senses:

- Post- because automation theory is challenged by growing social pressures for dignified work, sustainability, democracy, and local values and traditions.
- Post- because some groups are already appropriating technologies into non-industrial and new-industrial spaces beyond conventional circuits and logics of production and consumption.
- Post- because these groups seek to reconfigure these technologies according to social relations appropriate to plural histories, aspirations, and geographies.
- Post- because the technologies appropriated have genealogies including automation, and whose subversion today echoes human-centred alternatives proposed by workers in earlier struggles.
- Post- because new concepts and theory are required that engages critically and constructively with these developments and their future possibilities.

5: Workshop explorations in post-automation

The workshop interrogated some of the technological turnarounds in post-automation: from relations in human-displacing and human-disciplining automation, through to the creative experiments and prototypes for post-automation today. We shared and discussed empirical research papers, and we participated in group activities. The preceding sections were informed by these contributions, and illustrate the breadth of issues arising. The intention in this section is to give readers a little more of a flavour of particular discussions (see the Annexes for more details).

Some papers interrogated the challenges in adapting to automation (section three). We debated the discourse of industry 4.0, and thought about the human relations beneath the automations presumed in that discourse. The absence of questions of social justice and environmental sustainability in the Industry 4.0 discourse were noted and debated, such in relation to operatives turned into robots, in highly-controlled and disciplining work environments. We considered whether social justice and sustainability might be incorporated into a reformed discourse for, say, industry 4.2 (!), with claims for ecological modernisation, and participatory/liberating cyber-physical systems (e.g. FALC advocacy). Others argued that the foundations of Industry 4.0 were irredeemably problematic, such that transformations towards sustainability were unlikely within its functionalism. There has been little evidence of cleaner technologies decoupling growth economies from environmental degradation (Turner, 2008; Lin et al., 2018; Hickel and Kallis, 2019; Jackson and Victor, 2019). Marginal environmental improvements appear persistently unable to decouple aggregate environmental harm from economic growth at the heart of the greening of industry model.

Related to these discursive reflections were recurring cultural anxieties with automation since the 1950s. Whether fears about employment were realised as much through economic restructuring as with technological change, or the two were inseparably intertwined. If the latter, one can argue it is difficult to see how strategies to accelerate automation by socialising its benefits will really work, since the driving relations in automation are so inherently tied to capitalist political economy (as discussed above in section 3).

Nevertheless, might some reforms be possible, that better empower exploited groups within current social adaptations to automation; or perhaps even open space to new kinds of post-automation arrangements?

We learnt about the scoring systems the Fair Work Foundation is developing to appraise the social performance of platform services for ride-hailing, food delivery, and other tasks. Fair Work are piloting a system that adapts International Labour Organisation principles into a scoresheet for comparing commercial platforms in terms of workforce rights and practices. The intent is for these scores to reveal the human features in platforms, and

encourage the visibility of work conditions in the platform to become a basis for ethical competition and trading. The scoresheets help citizens choose fairer providers. And the data about work conditions are also being promoted in policy deliberations over legislation to regulate platforms.

Fair Work is one example amongst many in which the communicative affordances of digital technologies have been designed with different employment relations in mind, facilitated by, and in consultation with platform workers, platforms businesses, unions and other stakeholders. Wrapping around the automated task dispatching and rent extraction of the platform (Sadowski, 2020), is a post-automation device for making visible and pressing for labour standards undermined by automation. And the wider goal is to use that post-automation device to inform and enable institutions that regulate platforms and guide the development of more humane platform businesses.

Moving upstream, and into new technology development, we discussed emerging ethical frameworks for robots. Research was presented that is looking into the socio-political framing of terms of reference for robot ethics committees, and the networks of participation (and exclusion) that bring (or overlook) different perspectives in ethical designs. We considered whether and how a contending ethics might be expanded and re-oriented to express post-automation priorities, and permit more democratic and diverse negotiations in robot developments. Critical here is whether those norms are approached from a position seeking to anticipate, delimit and ameliorate harms (of automation), or open up and facilitate creative post-automation explorations for more socially useful technology deployment focused in human rights and welfare (Birhane and van Dijk, 2020).

These contributions were helpful for our thinking about post-automation because they begged questions about the settings in which sociotechnical experiments and interventions take place, and begged questions about when and how it is possible for powerful forces for adapting to automation might actually be opened-up to become more susceptible to constructive post-automation. The challenges in this were illustrated starkly with an ethnographic study of how hacker experiments with a collaborative robot arm in a makerspace. What looked like a relatively conducive setting for alternative experimentation, was actually shaped by prevailing expectations about robot arms, and deliberation focused instead on seemingly mundane applications. The negotiation of social and legal norms about safe use of the arm eclipsed the imagination for what collaborative robotics might look like in a post-automation world, even in this ostensibly open space.

Many workshop contributions looked in detail at specific sociotechnical practices that appear to embody some aspect of the post-automation proposition. As well as the collaborative robot arm, makerspaces appeared in several other papers, as examples in open-ended activity can make use of digital technologies hitherto associated with automation, but now deploy them in open and collaborative workshop settings that facilitate creative uses and adaptations of those technologies. Makerspaces were considered to hold considerable potential for introducing more diverse social values, knowledge and priorities into sociotechnical arrangements with these technologies. One paper analysed the development of small-scale production networks in Vietnam through such spaces, and the appropriateness of this alternative production and innovation model for the economic situation in that country. We also heard from examples elsewhere, how the adaptation of technologies into creative prototyping initiatives were being used to co-produce social change and inform institutional reforms. In some cases, new kinds of cooperative enterprise were being explored across these spaces. A paper looking at how digital platforms are being developed to account and attribute value creation in open and collaborative business models was notable here. As with platform co-operativism, it potentially offers a model for the longer-term resourcing and economics of post-automation activities.

Certainly, the facility with which knowledge, ideas and objects emerging from post-automation prototyping can replicate more widely or form the basis of economic activity depends upon the wider social and institutional settings mentioned above. Propagating post-automation is challenging when the wider settings emphasise scaling-up through commercialisation, and the conversion of the prototype into a product form suited to conventional global value chains making use of automating logics. We saw this in a paper looking at entrepreneurship in Mexico, and the personal and social tensions that arise when community-based innovation is scaled-up through an enclosing and marketing of the products of that innovative activity.

Whilst scaling through business development is not necessarily bad, the Mexican example reminded us that care has to be taken that other values are not eclipsed by the financial resource models involved. Two papers explored the values produced through careful use of sensor technologies by user groups, with the intention to empower their situation. In one case we looked at how community-based development of noise monitoring provided a citizen-centred and situated alternative to the Smart City strategy for comprehensive city operating systems. The qualities of the data produced collaboratively through the local platform proved more effective at mobilising people into seeking urban changes than data in the automated operating system. Contrary to Smart City expectations for

digital technologies streamlining urban management, the configuration of sensors and platforms by citizens in this case study heightened demand for old-fashioned community development.

The way data collection is situated and what it intends to mobilise became apparent in the second sensor paper also. Here small-scale farmers were provided with digital technologies for monitoring soil qualities. The intent was simultaneously to interrelate this fine-grained data with satellite data, whilst also supporting small-scale, sustainable agricultural practices. However, addressing each required a different approach to data collection and communication technology. The former emphasised the validity of farmer-generated data for input into wider-scale monitoring systems. The latter was more interested in how data generation as a locally-collaborative practice facilitated the mobilisation of other regenerative farming practices, by building up communities and learning networks. Such differences emphasise the importance of being open and reflexive towards the social relations being sought and prioritised through technological experimentation, which is central to post-automation.

Whilst workshop contributions demonstrated some methods useful for tracing post-automation at different scales, from ethnographic studies to discourse analysis to participatory-action research, amongst others, additional methods are needed for mapping and characterising post-automation across scales, networks and spaces. Absent in the workshop was attention to differences in post-automation in different sectors, and how sector distinctions might transform. So, for example, bringing platform cooperatives into play in the energy sector compared to the mobility or food sector, and new intersections between them.

A major theme in our group activities was the relationship between the post-automation proposition and the environmental crisis. Unfortunately, a paper looking at questions of repair, remanufacture and sufficiency in post-automation had to be withdrawn from the workshop due to illness. Other papers and discussions nevertheless raised questions about maintenance, repair and care for the materiality of digital technological, and what that might look like in a post-automated world. Such research and papers will be sorely needed in future. There were discussions about dystopias and utopias in relation to this issue. Whether rising inequalities and growing consumption, with automation implicated, can be addressed before societal breakdown and ecological collapse, and whether the idea of post-automation can really induce such a transformation.

6: Emerging themes

Across the many examples, we learnt how specific interventions can have profound implications, by pointing to the challenges and anticipations in post-automation. What kinds of institutional changes could better align with and consolidate the values and norms being expressed through specific configurations? How can an accumulation of specific post-automation experiences inform the development of parallel or alternative institutions (compared to those promoting automation)? How could institutional reforms embody post-automation in their design principles? What changes might open up greater possibilities for post-automation initiatives, whilst existing initiatives in that vein might reinforce the creation of such frameworks? Reviewing the discussions from the workshop, a number of themes appear pertinent to these broader institutional questions.

6.1 Openness

Opening technologies, knowledge and data was central to most of the practices associated with post-automation in the workshop. Whether it was Fair Work opening up the gig economy to social audit, or community-built sensing platforms that opened up participation in data mobilisation, or opening a technology to re-design in makerspaces. Openness highlights a very different mode of technological development compared to prevailing ideas around intellectual property and cognitive capitalism, and which currently dominate many innovation institutions. In order to understand the potential of post-automation we will need to explore what openness means across these different dimensions, and how openness facilitates appropriation and resignifications of digital technologies into different situations. How can openness be unpacked and negotiated; and what are appropriate ways to understand the different meanings and practices of openness in post-automation? And what about the corollary to openness, which is restricting access, whether to personal data, or closing off certain forms of encroachment, enclosure, and exploitation? How are the boundaries of openness negotiated?

6.2 Democracy

Democracy was generally implied than it was explicitly analysed in the workshop. Questions of democracy unsettle centralised and authoritarian models of decision making baked into automation theory. However, given the institutionalised power of the latter, in organisations, markets and politics, post-automation is disadvantaged in its democratic aspiration. Open practices within current social institutions can reproduce asymmetrical relations and hierarchies, whether around expertise, capabilities and material interest. Understanding democracy broadly,

as the cultivation of agency amongst marginalised groups to challenge such power, then what are the different dimensions to democratic struggle in post-automation? How are power relations unsettled beyond participation, in more conventional technology appraisal and investment institutions? What forms of social mobilisation open up most decisively to post-automation?

6.3 Human capabilities

Post-automation has implications for how we regard skills, work and learning. Post-automation is interested in expanding human capabilities (O'Donovan and Smith, 2020). Workshop examples illustrated how this works through processes that cultivate communities of practice in both digital and physical environments. Post-automation recasts in a new light the importance of tacit knowledge and situated knowledge in relation to the codified knowledges emphasised in digital technology. Developing new ways of learning and facilitating collective organisational capacities in post-automation will consequently be indispensable. What kinds of care practices will be required in post-automation scenarios based, for example, in relations of repair and longevity in digital infrastructures? And what about human capabilities in digital sociotechnical configurations respecting minimal resource use and contamination? Where are such capabilities being cultivated, and how are they recognised and valued?

6.4 New imaginaries for technology in society

Industrial societies usually associate technology with economic development, and human wellbeing with employment. However, with automation unsettling these ideas and presenting a future where the status of employment and production of value is set to change, post-automation provides a space to re-imagine alternatives to what technologically-mediated human activity means in terms of creativity, social responsibility, wellbeing, and the creation of value. How do people relate to the things they produce in post-automation societies, and how do people relate to one another? How can post-automation be further developed as a sociotechnical imaginary that is able to mobilise notions of shared wellbeing and sustainable development? What does work feel like in these futures? How can one reasonably build out imaginatively from specific initiatives, such as those presented at the workshop, and thereby inform more general visions for post-automation?

6.5 Enabling institutions and institutional change

While it is possible for groups to experiment in marginal spaces conducive to doing digital differently, ultimately, if post-automation is to develop, initiatives will need to network and understand collectively the broader frameworks required for conducive institutional settings. This includes rules of management and ownership, new regulations, public policies, training programmes, investment arrangements, attributions of value, and so on. Post-automation networks may take advantage of reforms being promoted by institutional entrepreneurs elsewhere, by presenting their initiatives as advancing those reforms. This is a huge challenge. If broader institutions are considered at all in post-automation experiments, then they tend to be conceived in anticipation of future institutions, in which post-automation is recognised and supported routinely; and yet those same initiatives find themselves evaluated and judged according to the incumbent institutions they wish society to move away from, and which shapes the resources and spaces open to experimentation today. There is a temporal glitch which must be bridged. What kinds of institutional setting are most open to post-automation approaches currently? Where are pressures for institutional reform building, and where post-automation initiatives might provide advocates with (sociotechnical) resources for informing the new norms?

6.6 Commoning

Post-automation implicates new, unforeseen pathways of development. Understanding how post-automation can help (or hinder) actors and practices in alternative economies is crucial. With arguments growing for post-growth economies (beyond GDP), so re-ordered and re-defined economic values could become reasons for cultivating post-automation arrangements. If, for example, longevity and adaptability in technologies becomes more valued compared to novelty and obsolescence, so the openness, participation and hackability of post-automation would become advantageous. Indeed, as specific post-automation practices develop, such as repairable devices facilitated by open technologies, so this might help enrich new value propositions for sustainable economies. How does post-automation reflect and reinforce these shifting values and orientations? An important notion in several workshop examples is the idea of commoning, and seeing technology as either a common resource itself, or contributing to some common resource or good. There were examples of knowledge commons, hardware commons, urban commons, and accounting techniques for recognising and sharing the value produced through collaborative work. And yet discussions also recognised how these elements in commoning emerge from and

underpin the corporate economy, for example, by providing code, prototypes, and entrepreneurial energy for exploitation, or improvising precarious livelihood activity for those excluded from more secure employment. How can recognising the common value in post-automation practices, contribute more to the building of more sustainable economies, rather than the shoring up of capitalist crisis?

6.7 Multi-scalar, cross-sectoral and pluralistic networking

The workshop illustrated vividly the multiple scales and plural situations over which post-automation arises: from the micropolitics of doing participative and more democratic technologies; to the intermediate level of policies, social mobilisations, business strategies, and institutional trajectories; to structural questions around industrialisation, economic development and technology; to the kinds of discourse that draw together post-automation, post-growth, and global responses to inequality, dignified livelihoods and the ecological crisis. Post-automation works across through networking across specific technology practices through to policy and strategic debates through to redefining a technological culture.

7: Conclusions

Many initiatives falling within a broad post-automation framing currently are marginal to the main thrust of technology development in society. At the moment, their potential rests simply in pointing to alternative possibilities to dominant trajectories. By revealing social choices and contingencies in all technology development, post-automation practices insert into public imagination and debates ideas beyond adaptation to automation.

Returning to our original question, what are the contours of post-automation societies, in which citizens play a more constructive rather than adaptive role in the development of its technology? Some of those contours can be found in practical initiatives like those covered in the workshop, and by considering what social, economic, cultural and technological changes around them might lead to their flourishing and spreading. We anticipated post-automation societies:

- Making greater use of open technologies including open to the social relationships that put them to work;
- Practicing innovation democracy in plural forms;
- Nurturing human capabilities that give equal weight to skills in community development as they do to technology skills;
- Opening up new social imaginaries for technology in the cultivation of dignified human creativity, environmental sustainability, and social equity;
- Co-evolving with new institutions that recognise and reward the values in post-automation;
- Recognising technology in commoning for socially useful production.

One future activity would be to elaborate these contours further, and turn the post-automation proposition into a more clearly articulated and argued manifesto and/or research agenda. Whilst a manifesto might be useful as an exercise and perhaps attract attention (there are many manifestos already), its aspirations are far from assured. We, therefore, need to learn more from the challenges confronting present-day initiatives in post-automation, and interrogate critically their prospects and conditions through a research agenda that addresses the contours above.

Our workshop did not do justice to the wealth of experience and possibility in the case studies presented, nor did the case studies cover the full variety of activity with different technologies, in different places, across different sectors, and involving and enabling relationship-building across different groups.

There is a post-automation research agenda to be developed, that can bring such diversity into dialogue, and where the themes and contours can be explored using multiple methods and concepts and analysis suited to post-automation. Indeed, the over-arching lesson from the workshop is that post-automation has value in convening multifaceted encounters and dialogue across diverse digital technology alternatives. By presenting a concept-in-the-making centred on human creativity, sustainability and democratic involvement, the workshop found common themes, whose further research and activity can inform collaboration, conviviality and creativity – the three C's.

References

- Bassett, C., Kember, S. and O’Riordan, K. (2020) *Furious: technological feminism and digital futures*. London: Pluto Press.
- Bassett, C. and Roberts, B. (2019) ‘Automation Now and Then: Automation Fevers, Anxieties and Utopias’, *New Formations*, (98), pp. 9–28. doi: 10.3898/NEWF:98.02.2019.
- Birhane, A. and van Dijk, J. (2020) ‘Robot Rights ? Let ’ s Talk about Human Welfare Instead’, in *Third AAAI/ACM Conference on Artificial Intelligence, Ethics, and Society*. New York.
- Hickel, J. and Kallis, G. (2019) ‘Is Green Growth Possible ? Is Green Growth Possible ?’, *New Political Economy*. Taylor & Francis, 0(0), pp. 1–18. doi: 10.1080/13563467.2019.1598964.
- Illich, I. (1973) *Tools for conviviality*. London: Harper & Row.
- Jackson, B. T. and Victor, P. A. (2019) ‘Unraveling the claims for (and against) green growth’, *Science*, 366(6468), pp. 950–951.
- Lin, D. et al. (2018) ‘Ecological Footprint Accounting for Countries : Updates and Results of the National Footprint’, *Resources*, 7(3), p. 58. doi: 10.3390/resources7030058.
- Matthewman, S. (2011) *Technology and social theory*. Basingstoke: Palgrave Macmillan.
- O’Donovan, C. and Smith, A. (2020) ‘Technology and Human Capabilities in UK Makerspaces’, *Journal of Human Development and Capabilities*. Routledge, 21(1), pp. 63–83. doi: 10.1080/19452829.2019.1704706.
- Pasquale, F. (2019) *The Second Wave of Algorithmic Accountability, Law and Political Economy*. Available at: <https://lpeblog.org/2019/11/25/the-second-wave-of-algorithmic-accountability/> (Accessed: 3 March 2020).
- Sadowski, J. (2020) ‘The Internet of Landlords : Digital Platforms and New Mechanisms of Rentier Capitalism’, *Antipode*, 0(0), pp. 1–19. doi: 10.1111/anti.12595.
- Sayer, A. (1989) ‘Postfordism in question’, *International Journal of Urban and Regional Research*, 13(4), pp. 666–695. Available at: <https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1468-2427.1989.tb00141.x>.
- Schwab, K. (2017) *The fourth industrial revolution*. Geneva: World Economic Forum.
- Smith, A. (2014a) *Socially useful production*. 58. Brighton. Available at: <http://steps-centre.org/publication/socially-useful-production/>.
- Smith, A. (2014b) ‘Technology Networks for Socially Useful Production’, *Journal of Peer Production*, (5). Available at: <http://peerproduction.net/issues/issue-5-shared-machine-shops/peer-reviewed-articles/technology-networks-for-socially-useful-production/>.
- Turner, G. (2008) *A comparison of the Limits to Growth with thirty years of reality*. Canberra.

Annex 1: Paper presentations and discussion

DAY 1

1. Christopher Foster & Claire Hoolohan - *Expanding Industry 4.0: Social science approaches to studies of technology change*

The paper explores the foundations of concept 'Industry 4.0', the methods used to explore this phenomenon and its potential outcomes by using social sciences approaches to move towards more critical perspectives about technological change. The paper raises a set of interesting questions that challenge conventional debates dominated by science and engineering disciplines about Industry 4.0, enquires to go beyond future-oriented methodologies and invite us to think about the outcomes of the Industry 4.0 in terms of social justice and sustainability.

The following issues were raised after the presentation:

- *Social justice and sustainability*
Should social justice and sustainability be the outcomes Industry 4.0? Although expecting these to be outcomes might seem biased, they encompass different alternatives that gravitate around issues of justice and sustainable futures that are needed more than ever to deal with some of the dangers we currently face as a species.
- *Industry 4.0 and being left behind*
There seems to be strong advertising of the idea that whoever does not get on board with Industry 4.0 will be left behind. Is that really the case? It seems that Industry 4.0 does not represent a valid alternative for some groups. On the contrary, some people selectively withdraw from this kind of processes, because they deem them unsuitable for their needs or interests. So, is the risk of not getting on board with Industry 4.0 really a problem or a tactic?
- *Post-automation as a framework?*
Framing social justice and sustainability as outcomes of Industry 4.0 or a post-automation alternative trajectory can be helpful but, to some extent, this proposal reminds us to frameworks like the Responsible Research & Innovation (RRI) -and other funding schemes and attempts to stir the course of innovation- where elements such as anticipation, reflexivity and innovation become an instrumental box-ticking exercise once they get into supranational frameworks, like the OCDE or the European Commission. Should we be concern about what will happen with the post-automation logic when it solidifies?
- *There is more than one type of justice*
The paper picked on organised labour and justice. However, social justice within the context of Industry 4.0 can have a broader scope; for instance, data justice and other notions around justice and capabilities can be elements to incorporate into the reflexions around this category. Topics like social inequality, democratisation, access and production are so intertwined that need broader understandings of justice. Furthermore, justice and sustainability are two dimensions deeply intertwined. In that sense, it is not enough to refer to social justice in a broader sense when Industry 4.0 is at stake; sustainability and issues around sustainable futures should be part of the discussion.

2. Caroline Bassett & Ben Roberts - *Automation now and then: Automation fevers, anxieties and utopias*

The authors show that recurrent automation anxieties occur in cyclical waves and explore how the debates in automation appear in culture. The term 'automation' emerged in the 1950s in a period when governments were engaging in it. Authors promoted the idea that automation was different from industrial mechanisation, that it could do for human brain what the 1st industrial revolution did to the human arm. In the 1960s emerged the idea of the Cybernation scare where the combination of automation and cybernetics would lead to job lessons, requiring government intervention in the case. In the 1970s the idea of a radical change lost energy and became more a transformation in production. This cyclicity is interpreted by some authors as consequence of pre-mature concerns with the consequences of automation. The authors, though, interpret it differently, stating that cyclicity is a reflex of a cultural phenomenon rather than a technological phenomenon. In the left, some authors argued that automation should be accelerated so that improving technological progress will lead to post-capitalism while others remind that social aspects, more than technological ones, are equally important for an alternative future.

The following issues were raised after the presentation:

- *Reactivation of cultural phenomenon*

Automation can be seen simply as a phenomenon that becomes more perfectly completed at each time, reflecting itself in the evolution of technology. But what seems to happen is a repetition in different models of how society sees machines resembling humans: first cybernetics then machine learning.

- *Real anxieties regarding job displacement*

Some of the anxieties, although cyclical, happened to take place and have real consequences at each time. What differs previous anxieties from current ones is that then it was not very clear what type of changes would occur, while now there is a more supported view that the transformations are not necessarily quantitative, but qualitative.

- *Conflicting views on the impact of automation*

Since history is written by the winners, there are different ways to interpret the relation between jobs and technology. Because anxieties would vary according to the exposure of the automation process, a more localised analysis could enrich the discussion, giving voices to small-scale actors. The automation in transportation, for example, allowed jobs in the Global North to be replaced by non-automated labour in the South. The choice for this type of technology was available due to the possibility of exploring cheaper labour overseas. In a different context other types of technologies, perhaps more transformative, would have had to have emerged to address productivity. Therefore looking back at the history of what people were imagining technologies to be able to do is important because it allows not only a contrast between conjectures and what really happened, but also allows a recovery of ideas about how capitalism can transcend its own means.

3. Tudor Ionescu - *Meet your personal cobot: Will it change you? Can you resist it?*

Ionescu endeavours an ethnographic study of GroundGarage, the largest makerspace in Austria, where cobots have been made available to the community in order to democratise technology. The use of cobots for personal use, detaching it from its former industrial character, challenges the need for standards and regulations present in a factory. Both individual (makers and hackers) and institutional actors (industry) influence each other and try to appropriate benefits in this space. Can mutually beneficial exchanges occur in such a trading zone?

The following issues were raised after the presentation:

- *Power relations*

Power relations are central to the discussion of the evolution of the collaboration between users (makers and hackers) and developers (roboticists and industrial scientists). There is a conflict regarding the safety standards, since users, oppositely to industrial workers, engage in personalised uses of cobots.

- *Innovation in makerspaces*

The combination of an analysis of machines as arms-and-hand tools and the use of this analysis for industrial application might lead to a localised interpretation of the innovativeness of applications. Another domain where trading zones could be explored, for example, are the assisted living or prosthetics machines.

- *Safety fences*

Cobots are good examples of means of production that can be operated behind safety fences. It supports the idea that it is possible to think about different ways to address risk, regulation, capability changes and socio-technical aspects. One general lesson from the cobots example is that standards were not needed for more than individual safeness.

- *Access to cobots*

Although the cobots are supposed to be used by a large community, there is a need for taking courses. This not necessarily helps to democratise access to the machines and is required by the makerspace regulators.

DAY 2

1. Raúl Tabarés Gutiérrez - *Facing the transition: Visions around Industry 4.0 from makers and manufacturers*

There were funded collaborative partnerships between makers and manufactures aimed at accelerating the development of open source prototypes. From interviewing the actors involved in this collaboration the author collected insights about motivations, visions and how they perceive the factory of the future and the road to Industry 4.0. Clear differences were noted due to the remoteness in society. While makers were led by producing positive social impacts and detected the transition towards industry digitisation as an opportunity to introduce creativity, openness, sharing and sustainability in the production, manufactures perceived innovation as a tool to compete and were sceptical about the feasibility of digitisation. Nevertheless, the author argues that industry digitisation could be used to transfer grassroots' values to the manufacturing sector, yet not before a significant policy agenda.

The following issues were raised after the presentation:

- *Human agency versus automation*

New technologies can be used both to save human labour and to deal with labour negotiation (by displacing jobs).

- *Contacting and bringing together different actors*

The author acknowledges the difficulties in putting together a language to conciliate the interest of both actors. It was more difficult to engage manufactures than makers in the partnerships. Very often they were not aware of what makerspaces represent. Identifying common values between them could represent a way to construct further connections.

2. Richard Heeks, Mark Graham, Paul Mungai, Jean-Paul Van Belle & Jamie Woodcock - *Fairwork and the Gig Economy: Seeking Decent Work Standards for South African Platform Workers*

The paper focuses on the relation between digital platforms and the future of work (specifically the gig work). It reflects on the fact that standards about decent work need to be adjusted when it comes to digital platforms. Based on a study of the attitudes of 70 workers across 11 digital platforms, the study elaborates a rating instrument based on five principles (fair play, fair conditions, fair contracts, fair management and fair representation) to promote the adherence of digital platforms to decent work standards.

The following issues were raised after the presentation:

- *Tensions between traditional workers and gig-workers*

The gig-work might cause conflicts between traditional workers and those who are enabled by digital platforms. There seems to be a trade-off in the introduction of the gig-economy: while it expands work opportunities and provides more flexibility for workers, it diminishes the ability to capture the workforce in other more conventional sectors.

- *Can we equate the gig-work with informal work?*

The nature of the work carried out through these platforms might, to some extent, equate informal work conditions in the Global South. In that regard, should we reconsider our perceptions about regulation since these platforms are enablers for a constant seek for income in a similar way as informal work do? The authors argued in the discussion that while informal jobs are not often a choice (i.e. it is the consequence of lack of options), working with these platforms is (in terms of preferences related to income and flexibility). However, by working around three leverage points (creating regulation, rating the platforms and consumer preferences), more fair conditions for these workers can be created.

- *Traceability, individual trajectories and the advantages of being a local*

Where are the workers coming from? Some of the Uber drivers were truck drivers in the past, and their decision to become 'independent workers' was made based on personal reasons (e.g. expending more times with their families). However, the circumstances are different for those who are foreigners. Getting a job or a decent salary seem to be hard for non-locals, so these platforms offer them an alternative even when this means trading off their security (e.g. Uber drivers are vulnerable to crimes and being killed in South Africa).

- *There is Uber and Uber*

The study provides evidence that might support the idea that these platforms behave differently depending on the country and, therefore, have different strategies. For instance, while Uber has developed campaigns to change regulation in the US, there is no evidence for similar behaviour in South Africa yet. Likewise, it seems that not only Uber but also other digital platforms in South Africa show sympathy for a social responsibility approach. It appears that several of these platforms are willing to change certain aspects of their management style and relation with the workers based on this sympathy, which might facilitate a transition towards decent work standards.

3. Javier Jimenez, Belén Albornoz, Ángel Gutiérrez & Mónica Bustamante – *Post-Automation: an alternative to post-conflict in Colombia*

The paper explores how peer-produced mode of production becomes an alternative to technological trajectories in a post-conflict era by analysing the role of human agency. The paper presents the experience of 'Labic X La Paz' through 10 projects which aimed to help to overcome violence related experiences in specific communities in Colombia. The identification of problems, as well as the alternatives to face them, have been carefully tailored using a participatory approach that contributed to reshape social relations, subvert (in some cases) power dynamics and use technologies as means to achieve the objectives faced by these communities.

The following issues were raised after the presentation:

- *Power relations and different sources of expertise*

How can asymmetrical relations or domination dynamics be recognised? The authors mentioned that most of the communities had asymmetrical power relations when they arrived because it was challenging for the communities to recognise different types of expertise and knowledge. The authors explained that one of the goals of the programme was to empower each one of the communities so they can see themselves as equals in regard to other actors.

- *Impact and evaluations*

The researchers used three types of assessments that were community-centred. First, the community evaluates its own transition comparing the present with the moment in which the intervention started. Second, the researchers evaluate how the network changed (using social action network theory), and how the relations among it reconfigured. Third, in the long term, the researchers evaluate what initiatives continued over time and what others disappeared. In the case of Labic x La Paz, technologies are not evaluated per se; instead, the focus of the initiative is on social relations and how these change in a post-conflict scenario.

- *Auto-perceptions and the relationship with the community*

The researchers identify themselves as an additional voice; their role changed depending on the stage of the project. The projects started with the stage of 'understanding' the problem, followed by a 'deliberation' stage, and finally by a 'communication' stage. During the deliberation stage, the researchers are an additional point of view, while in the communication one, they facilitate the translation of different values and points of view. The researchers consider that they mostly accompany the process, as the communities do most of the work themselves. The researchers thus accompany and facilitate methodologies only when a community is interested in engaging in the programme.

- *Are there limitations to this type of interventions?*

Limitations depend on the point in time and the context in which an intervention is carried. In Colombia, one of the main limitations is to build a trusting environment. Second, there exist power relations that cannot be reconfigured; for instance, the relations the community may have with the military or with other illegal actors (drug cartels) are hard to change. However, there are some experiences where communities, after empowering themselves, have prevented scenarios in which they needed to engage with this type of actors.

- *Learning communities and learning as an experience*

The communities need to engage with what happened in the past to reconfigure the present and redefine the future. In that sense, not only the communities revisit failure and successful experiences in their pasts, but also the cooperative nature of the projects has brought collaborators from other Latin American countries who have shared inputs about similar experiences to imagine possible futures.

- *The role of the technologies*

Technological tools can be incorporated in any intervention at any stage because interconnection plays a key role in achieving the objectives of programmes such as Labic X La Paz. The programme aims to empower communities through the social reconstruction of networks and uses digital technologies to facilitate interconnection through

the use of information and interaction. Technologies, in that regard, have addressed the need that people in Colombia have to be 'connected'.

4. Ryo Seo-Zindy & Richard Heeks - *The emergence of digitalised small-scale production networks in the global South: a case study of Vietnam*

Emerging digitalised small-scale production networks in Vietnam are formed by makerspaces, their production partners and start-ups. The author sees it as an alternative production and innovation model and conducts interviews with the actors involved in order to account for it. A network of actors that did not fit conventional production sites was observed: customisation of products and services enabling digitalisation of local SME practices, on-demand and on-location services and individual manufactures are some of the examples listed.

The following issues were raised after the presentation:

- *The locus of clients*

The makerspaces are currently focused on niche production, usually for local clients rather than global ones. There is no focus yet on mass production.

- *Funding*

Being the technology used in makerspaces expensive, some are not necessarily financially sustainable and have to ask for funding from the government and universities and find partners in the private sector.

- *Origins of the Vietnamese makerspace model*

The focuses of makerspaces are varied. As a common feature their background are in local networks producing small-scale goods and services.

- *Intellectual property*

In another case the global South, South Africa, IP is increasingly becoming seen as an asset that could bring possibilities of exploiting profits, although yet there is small concern and acknowledgement of IP matters. In Vietnam actors have a very liberal approach towards IP but at the same time a lot of the knowledge used is based in open-source technologies. While there is a possibility that contributions are being acknowledged inside networks it is hard to tell the same for contributions outside.

5. Elvis Koroku Avenyoa, Erika Kraemer Mbulaa & Chris Armstrong - *Are makers the new 'alternative'? Evidence from Africa's makerspaces*

The paper, by reviewing secondary data from the Open African Innovation Research, found that makerspaces in Africa, regardless of their configuration (community-based, university-based, government-based or hybrid), are contributing to the development of skills and capabilities of their users, are creating value, and advancing new social values and reconfiguring social relations. In this regard, makerspaces will be important in the post-automation era, mostly in developing countries, since they can generate value and help to tackle some of the most pressing gender issues.

The following issues were raised after the presentation:

- *Demystifying the use of technologies*

Recent studies have shown that new 4IR technologies in makerspaces are contributing to demystify the implications of using new technologies for women and young adults in Africa. Although there is no evidence for South Africa, experiences in Cairo and Libya showed that users realise that they can become entrepreneurs by approaching these new technologies in a more playful way.

- *Social ecosystems around makerspaces*

Although there seems to be some progress regarding access for women to those spaces, most makerspaces continue to be male-dominated environments. Male users (primarily white male) often have the resources to buy these technologies, which define the ambience of these makerspaces. However, there are more nuances regarding the presence of women in the case of the government-based makerspaces, but it is not the most common scenario. Makerspaces are technology-driven spaces; to what extent the incorporation of female-friendly technologies can help to make those spaces more welcoming for women coming from more traditional backgrounds? Moreover, what do the infrastructure and the design of the space tell us about welcoming women?

These aspects should be considered when reflecting on the potential of makerspaces to create value and advance new social values.

- *Technology and social relations*

An interesting contrast between the South African case and the Labic X La Paz is that the latter focused on the social relations first and then on how technology was incorporated to support processes of social reconfiguration. Contrarily, in the case of the makerspaces in Africa, the technologies were the ones shaping the social relations around them.

- *Overseas influence in makerspaces*

In the secondary data reviewed by the authors, the influence of China, as well as multinational companies such as Google, IBM, Uber, etc., seems quite evident. These actors are trying to make inroads into the makerspaces taking advantage of the fact that, often, makerspaces do not have enough resources, which make them lean towards a more profit-oriented profile; however, some of the makerspaces disagree completely with this idea and argue that they are open source and do not want to engage with these corporations.

DAY 3

1. Carmen Bueno, Patricia Alvarado & Arturo Zepeda - Scope of young entrepreneurs' contribution to post-automation in Mexico

The trajectory of a techno-entrepreneur is analysed considering differences between centre and periphery within a socio-technical system. Findings point out that post-automation can benefit from the democratisation of technology as it contributes to the public domain of value production in the communities of practice, blurring the gap between the global north and the global south. Nonetheless, the case illustrates how these new repertoires of action, backed by soft regulations, strengthen the control that core institutions and agents have over dominant resources such as funding and positioning innovations in the world market.

The following issues were raised after the presentation:

- *Different centres and peripheries*

Centres and peripheries in socio-technical systems do not refer to physical spaces but to the way in which social relations are structured. In this regard, it is possible to map different peripheries, which constantly multiply and self-fertilise around different centres. However, this paper identified a clear centre-periphery dynamic that is mediated by economic power where competition and asymmetries of resources determine how different actors can be placed in relation to the centre. This reflexion also highlighted the importance of belonging to a community of practice that can be situated in either of these spaces, since the resources available in these communities enable the agency of these actors within a socio-technical system.

- *Ethnographic heterotopias*

Ethnographic approaches are of extreme value in the analysis of social relations within and between centres and peripheries. However, they often have (spatial, experimental and interior) limitations; that is, ethnographic heterotopias. In this regard, certain assumptions about access to resources and asymmetrical power relations that arise as the consequence of the utilisation of these approaches can be challenged by evidence that could not be accessed due to ethnographic heterotopias (e.g. unobserved powerful agency). Despite ethnographic methods' limitations, the paper collected evidence that pointed to the entrepreneurs' skills as an asset that can help to challenge power structures.

- *Beyond position: relations' outcomes and scales to succeed*

When reflecting about centres and peripheries, not only the position of the actors counts but also what comes out of the relations they establish despite their position. Their position and relations can signal their opportunities to succeed. However, 'success' might adopt different connotations depending on the community of practice to which these actors belong. In this sense, the values, the spirit and the outcomes of the relations in each community need to be taken into account when enquiring about 'success'.

- *Invention, manufacturing and communities of practice*

The paper showed a clear relation between invention and the communities of practice. Are these dynamics altered when manufacturing is at stake? Would be focusing on networks an alternative? 'Communities of practice' is a virtual relation that can also be analysed in terms of networks. The communities of practice analysed in the paper are a good example of co-creation, cooperation and self-regulation. Once the manufacturing stage takes

place, different and external regulations come into play and alter the co-creation, cooperation and self-regulation dynamics. The communities of practice, thus, change because their role change and they become part of a larger value chain.

2. Raquel Ajates and Mel Woods - How can post-automation developments such as new sensing technologies and big open data come together to foster more democratic and sustainable local and at-a-scale environmental monitoring? The case of the GROW Citizens' Observatory

The authors investigate the case of the GROW Citizens' Observatory, a project that seeks to create collaborative soil data from low-cost sensors that small-scale farmers apply in their lands. In particular, they are interested in the tensions that arise from the control of the data and the technology and user experience. The data feeds a European Space Agency satellite that uses it in extreme weather events predictions. However, challenges arrive when the contributors are to use the big open data for their own practices.

The following issues were raised after the presentation:

- *Different support for traditional large scale automation versus post-automation in agriculture*
Agriculture policy is European Union's most expensive policy, but there is no integration nor homogeneity in the type of policy aimed at. There are from subsidies for dominant food systems to support to improving the image of farming in concern with rural emigration.
- *Reliability of the data produced by participants*
Scientists are sceptical about the credibility of the data produced, so some measurements were developed to improve its quality; for example, the implementation of pre-data collection mechanisms such as testing and protocols.
- *Other ways to produce sustainably are also promoted*
Besides the use of data by the farmers other practices also promoted are regenerative agriculture, permaculture, debates on monoculture versus polyculture, trial of different methods that can be applied, and the use of apps to engage farmers in sustainable practices.
- *Data availability, usability and acknowledgements*
There is a lot of efforts in order to facilitate the use and interpretation of data by the participants, for example, in the form of online spreadsheets allowing for visualisation. The participants were asked whether and how they want to be acknowledged in the project.

3. Adrian Smith - Digital technologies and community developments in post-automated cities

This paper uses a case study of neighbourhood politics to explore relations between digital technologies and community developments. In so doing, the analysis contributes some 'post-automation' insights to Smart City research. Specifically, the paper investigates how residents of Plaza del Sol in Barcelona made use of digital technologies to press for action on noise nuisance associated with social activities in the square. The paper argues the automation of urban processes does not reduce the need for older-fashioned, human-centred community development.

The following issues were raised after the presentation:

- *Data and policy approaches*
When data is used to inform policies, often the focus is on the data itself but not on the people. The cases in which people are involved in generating the data also reflect added value that emerges from the engagement. Thus, the engagement process and the outcomes of that engagement (e.g. people making sense of the data) have value on their own. To what extent acknowledging this value can help to shift from data-driven policies to data-informed policies? In the case of the latter, people making sense of the data can bring into the picture deliberation processes regarding what to do to address the problem. Post-automation thus recognises the centrality of the social element as well as the plurality that comes with it which are not recognised or under-appreciated when data is the focus.
- *Intergenerational solidarity in the public space*
Spain cities often portray a conflict between young people and older citizens that do not agree with social practices such as the 'botellón'. Technologies have been contributing to foster intergenerational solidarity. The cases in which the action is framed around cooperation between young and older people have shown that

technologies allow new forms of interaction and spark new spaces for dialogue; so, technologies are underpinning social processes. Technology cannot transcend the social issue. In this regard, we need to map disconnections and identify how technologies can help.

- *What is, what could be and what should be...*

It is key to identify the 'what is' when we are dealing with phenomena that bring together social relations and technology. Only when the 'what is' is identified, the 'what could be' and the 'what should be' in regard to that technology can be mapped. Post-automation is about mitigating the 'what could be' and trying to find ways towards the 'what should be'. Nonetheless, we need to be mindful that the technologies available are constantly inflecting the 'what is' question and, as a consequence, are leading us to the 'what should be'. Different technologies legitimise certain forms of knowledge (e.g. noise monitors and codified knowledge) and pose a challenge to democratise action around them. That is why it becomes more and more important to identify spaces for deliberation driven by the communities. For example, although Smart Cities is a European Commission project, when it is adopted by a city, landed in a community, is theirs to decide the 'what should be'.

4. Cian O'Donovan - Governing robotics through ethical standards

Standards are used to reach consensus on ways of doing things and mitigate the risks encompassed by new procedures or technologies. The author investigates the creation of ethical standards for robotics – the rules emerging and the actors involved in the decisions – allowing reflections on the governance of robotics innovation. Further, post-automation potentials for participative governance that standards bring are listed and discussed in terms, for example, of human agency and sociotechnical relations.

The following issues were raised after the presentation:

- *Ethics towards robots*

As robots become tend to become more frequent in everyday life, the issues of ethical standards to live with them arise. Although not legally established, the values that should form the ethical framework to deal with human-robots interaction already exist, independently of the type of relation that may occur, be the robots helpers, workers, companions or colleagues.

- *Ethics and standards*

Although standards are helpful in order to make things work, ethics are not necessarily needed to do so. Once things actually start to work important issues to consider are who is responsible to monitor algorithms, how professional norms (such as IEEE norms) are policed when they get deviated, how standards can be used to avoid reflecting on and considering further ethical issues, how standards can help normalise practices in technologies that are opaque to most people (e.g.: Deep web and encrypted protection systems).

5. Alex Pazaitis - Capturing value in open innovation: the case of Sensorica

The author discusses a new form of social production named commons-based peer production (CBPP) in which value derives from contributions from different participants. The case study analysed is Sensorica, a Canadian open enterprise that produces open hardware sensor technologies by coordinating resources from multiple sources. Sensorica developed an accounting system to capture contributions and assess distribution of value that is insightful for the study of CBPP (where value is not necessarily market-exchangeable) and open innovation (seen as a radical transformation in productive processes that has collective knowledge as input and socially valuable products and services as output).

The following issues were raised after the presentation:

- *Value creation*

Economics tend to measure value by the amount of time spent in the production (value as an input). In the networks of Sensorica participants do not impose how the inputs are supposed to be measured. They employ diverse forms of contribution (testing, marketing, programming etc.) that in a later stage will guide the division of revenue.

- *Acknowledging contribution in open science*

In "traditional" science quotation is the usual way to acknowledge a previous contribution. Metrics can then be constructed in order to measure how many times works are cited and knowledge is shared. The more times a piece of knowledge is shared the more it is valuable. But in the case of Sensorica this does not apply. A

possible idea to explore the monitoring of sharing knowledge and contributions is by social debt, in which people acknowledge other actors but it does not have to involve financial payment of the debts.

- *Accounting value*

The contributions are logged in the system as they are been completed. And the same is done regarding the interactions with suppliers. But because some products do not make it to the market there is no way to know the numbers of sales and revenues ex ante. The monitoring of contributions is made in an accounting department, but is transparent and democratic.

- *Production and risk management*

Regarding the redistribution of risks, being Sensorica a meritocratic network and not an egalitarian one, there is reciprocity in the distribution of revenue but there is not much solidarity to participants regarding the resources applied to a project in case it fails. The participants see themselves as affiliated members rather than freelancers producing outsourced services. Nevertheless, there is not form of social protection.

Anex 2: Post-automation group activity

The first half of the activity aimed at imagining post-automation, particularly, its spaces and drivers, allowing for a utopian approach if necessary. Based on the events of the first day (where relevant themes to post-automation were compiled), participants were asked to reflect on the issues that matter most to them (items that they care about and can change the world – actors, drivers, visions, purposes etc.), write them down in paper sheets and place them on the floor, clustering ideas where possible.

The participants were then asked to approach clusters and themes they relate the most, and groups started to form. After some rearrangements of both people and papers, five groups were created. They were invited to pick up the papers and find a table to sit down. The groups and some of the papers collected were:

Group 1: Adrian, Alex, Belen, JP, Sid & Tudor – Commoning, Prosperity, Growth, Open peer production of goods, Against authoritarianism, Respect, Diversity.

Group 2: Mariano, Melina, Raquel, Ryo – Scarcity, Environmental collapse, Climate change, Zombie apocalypse, The 0.1% mega wealth, Running the train over the cliff.

Group 3: Ed, Elvis, Paul, Raul, Richard – Migration, 20h-week, Universal social problems, Stop digital evasion, Meaningful work, Decent jobs for all.

Group 4: Ben, Christopher – Broken devices, Repair, Time & choice.

Group 5: Carmen, Cian, Monica, Patricia – Co-AI, Earth, Care, Edible landscapes, A world for every (body/thing), Conviviality of people, ecologies and artefacts, Communities, Equitable decarbonisation, Fulfil people's potentials.

I. First Part

After the groups were formed, they were asked to consider the three following questions and invited to present they reflections to the rest of the group in a performative way.

- Where does the overall theme stand in time (present, past, future)?
- What understanding of post-automation is addressed?
- What hopes, values and ambitions accompany this style of post-automation?

Group 4: A past approach

The group brought to the room an old disposed TV/VCR to illustrate the “repair” theme. It brought together issues such as how products are manufactured, how legal issues may apply if one wants to repair a device, appropriating and shaping technology, open software and open hardware, the online culture of repairing, and sustainability – when rather than buying/making something new, it is possible to fix what already exists.

Group 2: A present approach

In a scenario of collapse and climate change, the picture that the group presented of the society is one of zombies marching to the edge of a cliff. Some of the issues considered were the circular economy, preservation, different ways to make the planet work in a sustainable way, traditional and tacit knowledge, local practices that can

suggest a more harmonious living. Post-automation could lead to using the idea of zombies differently: instead of humans blindly marching towards destruction, institutional zombies could be created, for instance, to eat plastics out of the oceans.

Group 1: Not too far from now

A robot is depicted being used in authoritative and uncoordinated ways by several humans, confusing a machine that tries to adapt and handle all the orders. At some point, the robot rebels against the human masters and reverse the direction of commands.

Group 3: A future approach

The group suggested a view for the future that delivers better distributions of income, universal basic income, alternative ownerships, heavily regulated markets (the competitive aspect is eroding the labour factor) and data commons.

Group 5: A far-future approach

The group focused on “care and Earth”. They presented a basket which is a representation of the world as some communities in South America perceived it. Inside it were placed all the things they care about, such as actors with agency, moving away from control and towards inclusion and a human-oriented approach to AI that can reinforce democracies.

The following issues were raised after the activity:

The visions of the future discussed and envisioned presented some common features. First, they were not completely utopian and, therefore, have a high degree of feasibility for the future. Second, the visions reacting to an industry-dominated future were not urban but pastoral. This highlighted the fact that actions of particular human groups can impact communities (not necessarily the human ones) that do not have the means to raise their voices and be heard. Third, visions focused more on social aspects and values than on technologies, which highlights that humans and their relations are at the centre of what is considered more valuable, and invite us to think on how we can be stewards of change. Lastly, regarding the ethical application of technologies, social sciences research is often required ethical approval before undertaking certain activities; however, in other disciplines that do not directly involve humans, this is less common, although equivalently necessary since such activities end up having an impact on humans.

II. Second Part

The aim of the second part of the activity was to consider the values underpinning post-automation, and consider the institutional challenges (normative, cognitive, regulative and economic) that limit or deflect the enrolment and uptake to post-automation. So, in the first 30 minutes of the activity, the participants were asked to write down the practical barriers or accelerators for each one of the scenarios that they imagined in the previous activity. In the following 30 minutes, the participants were asked to write down the slow-downs and workarounds for each scenario. Finally, the participants reflected on the uncertainties and risks of the alternative pathways they envisioned given the barriers, accelerators, slow-downs and workarounds previously discussed.

Some cross-scenario commonalities:

Accelerators:

Some of the salient themes across ‘accelerators’ are collective forms of organisation, responses and ownership (commons), cooperation, openness (of knowledge production, innovation and licences), diversity, empathy, incentives (both to reward and sanction), and finally, human-centred technologies and the idea of economic progress.

Barriers:

In regard of barriers, some of the salient themes are business as usual (consumerism and a growth based economy), societal vices (like corruption, crime and capitalism), the rise of political extremism, exploitation and class struggles, and the lack of societal awareness and shared visions.

Slow-downs:

Some of the salient topics across the scenarios for the ‘slow-downs’ are austerity, social numbness (amusing ourselves to death), climate and economic crises, pandemic diseases, consumerism and envy-accumulation, and individualism and lack of citizenship.

Workarounds:

Some of the common ‘workarounds’ for the scenarios aforementioned revolve around strikes (climate, workers) and resistance combined with individual actions (e.g. recycling), public deliberation and mobilisation, visibilisation of key issues such as commoning and adaptation.

Among the risks, the participants identified mostly natural disasters, lack of freedom, inability to adapt and inappropriate policies. Finally, regarding the uncertainties, the participants highlighted that different initiatives or claimed-to-be-necessary activities, are in fact, uncertain in terms of their outcomes. The discussion about power dynamics and uneven resources has cut-across the three days of the symposium, and is again reflected on attributing uncertainty to themes such as alternative growth, new forms of digital unions/organisations, the perks of technological development, new data laws and regulations and building bridges with other species.

Annex 3: Final reflections

The following reflections arose during the last session of the Post-Automation Symposium.

The centrality of the human aspect: agency and communities

- Automation is about machines, computers, and putting technologies in place, while post-automation is about rediscovering the importance and centrality of human relations. Thus, ‘post’ does not refer to what comes after, but to the transcendence of the human aspect and the reinvention of the human role within the debates of automation.
- Several of the discussions that took place in the symposium emphasised collective human agency, not only human agency as individuals, but a more collaborative understanding of the interplay between technology and society. The debates about agency are now much more specific. It is not about how to empower ourselves as individuals, but as groups, as communities of practice, and communities in general.
- For clarity and fairness, post-automation needs to state its assumptions regarding the stakeholders: who are the actors involved, who gets to be represented in the discussions, and how differences can be acknowledged. This will then allow post-automation debates to reach a next step, where issues of use and access can be debated. Are there solutions for everyone? How to create bridges for the ones without access?

Post-automation and sectors

- Post-automation works well as a boundary object since it can bring together different approaches and settings. However, it seems that exploring cross-sectoral issues and how post-automation is relevant for them is still missing. For instance, one of the significant changes coming is the electrification of transport and the structural transformation of the energy sector towards renewals; we will not be able to deeply understand these changes without taking into consideration the role post-automation is playing/will play in these transitions.

Post-automation and the extinction cliff

- We are in an express train to catastrophe in social and environmental terms. Post-automation in this context is not a switch to another track because that track does not exist. Post-automation, however, can lead us to a space outside the rails that is more promising to avoid falling from the cliff.
- We don’t have a blueprint for the future nor is entirely desirable to create one but rather to imagine processes that might generate sustainable outcomes. Most of the discussions revolved around the type of processes that might have the potential to deliver sustainable outcomes. So, the question is, how can those processes be circulated more broadly, reach more mainstream thinking, and be legitimised?
- Post-automation works as an umbrella description for alternative frameworks to make sense of technology and society, and how one shapes the other, in a mild deterministic trajectory because post-automation helps us to acknowledge that things are moving forward in a certain way, but also that there is room for actors’ agency to shift that trajectory towards more sustainable directions or, at least, create the mechanisms to control the pitfalls of that trajectory once unprecedented events take place.

The flipping power of post-automation

- Nowadays, we face contradictions, such as having emancipatory technologies used in exploitative ways or sharing infrastructures that are not about sharing. So, there seems to be a need for a framework to make sense of the ambiguity that comes with the development of such technologies and concepts.
- In addition to this type of frameworks, post-automation can help to flip things around. In this sense, what

concerns post-automation is what happens when technologies designed to be exploitative and controlling are used in a more liberating and socially-oriented way.

Ideology, conceptual frameworks and methodologies

- There seem to be three common elements emerging from the symposium. First, an ideology for delivering sustainable futures that can be captured in a manifesto. Second, an array of conceptual frameworks that can be systematised and used (e.g. agency, socio-technical systems, etc.). Third, a variety of methodologies that can support future research endeavours. The elements in these three categories (although more work around conceptualisation is needed) can allow building bridges of understanding with other audiences and disciplines.

A manifesto

- It would be useful and interesting to draft a document about where are we, what the methodologies we are exploring can offer, and what are the common conceptual frameworks we are using to then build a network over a period of work (from one year to eighteen months) with the specific intention to draft a research agenda based on the research projects that we brought together.
- A manifesto, in that sense, could explain why post-automation is needed (to tackle social injustice and environmental crises) and what this construct promises, and also helps us define the kind of audience we should be targeting.
- Analysing to what extent the practices and differences exposed in the symposium challenge particular issues (post-conflict in Colombia or lack of access to basic services in makerspaces) can help addressing more specific targets regarding social justice and sustainability for a manifesto. General challenges that might impact, for example, both global North and South, would require different measurements depending on the local conjuncture.
- The papers have a lot of richness regarding knowledge, traditions and methods that can be used to start a future research agenda, which means that the symposium allowed to gather material to start.

Industry 4.0 and post-automation

- One aspect less discussed was the use of similar terminology (Industry 4.0 and post-automation) and whether we are all on the same page regarding their meaning. Is post-automation a trend? Does it mean moving away from and supersede Industry 4.0?
- Post-automation is an opportunity to theoretically reach tools to analyse issues of common interest. More than being a phase (given the post prefix), it is a conceptual opportunity to analyse what is going on right now: if not a consensus, at least what is at stake, the Anthropocene, the commons etc. The prefix post might lead to the temporal aspect of automation rather than the alternative one (that relates to different spaces and practices), which seems to be what most people relate to; but, also, it might bring the idea of distancing oneself from past experiences, which is far from being what was proposed here.
- If Industry 4.0 can be interpreted as a socio-technical imaginary, then post-automation can be its counter-imaginary, an (or 'the') alternative to it. Industry 4.0 is already being discussed among engineers as an obsolete idea due to its disrespectful practices (to both humans and technology) and for being conceived as a marketing term used to fund questionable endeavours in the face of Eastern competition.

Waves of appropriating technologies: why is post-automation different?

- It seems problematic to define why post-automation is different from automation and why this time it is different from previous waves of automation. More specifically, from the different waves about appropriating technologies. Is technology pushing human agency? Are humans responding to technologies? Why is this time different?
- In the past, the discussions were about technology and democracy. For instance, in the '60s, the worst scenario imaginable was not even close to the environmental and social consequences of the misuse and abuse of technologies that we see nowadays. That is why this discussion is more necessary than ever.
- Post-automation looks for new ways to say something or to make something. What are the settings that allow us to discuss these new ways? Post-automation represents a shift that invites us to think about how to put in the research agenda issues that mean more than just research; for instance, how to discuss value, sharing, commons. Post-automation, in this regard, is more than a mere research agenda.
- Automation has been part of the debates in different points in time and, as a consequence, diverse antithetic responses have arisen. However, post-automation can be a normative synthesising of these ideas and help us to make sense of the process that we acknowledge will continue taking place (i.e. the train is falling from the

cliff) to then focus more on viable alternatives.

- Post-automation presents different possibilities for interpreting a new world that previous socio-technical modes could not. There is now a possibility to integrate different perspectives, such as industrial, manufacture, sustainability, ethics, governance etc.
- The benefits of the current mode of production and the automation chapter of it have already been distributed. Intellectual Property makes sure knowledge is owned and protected. Post-automation could be seen as a way to manage the inequalities that arrive from automation and help to correct its mistakes.
- Post-automation is stating that automation is not the way to address contemporary issues. It helps to build views for where to go beyond this narrative of big-data, robot-driven, genetic engineering etc. Furthermore, it gives us the chance to use an epistemological construct of concepts within practices, to study what has passed and have an eye on what is to come.

Efficiency

- Automation means efficiency and economic growth, while post-automation does not necessarily disregard efficiency and growth, but translates efficiency and growth into more human, social and planet dimensions. Post-automation, in this regard, should have a more social and environmental approach that acknowledges that while the human aspect is essential, it needs to be seen in regard of planetary boundaries; that is, to see all these elements as a whole.
- How can post-automation help us trigger discussions beyond maximising revenues or efficiency and, for instance, focus on things like 'sharing'