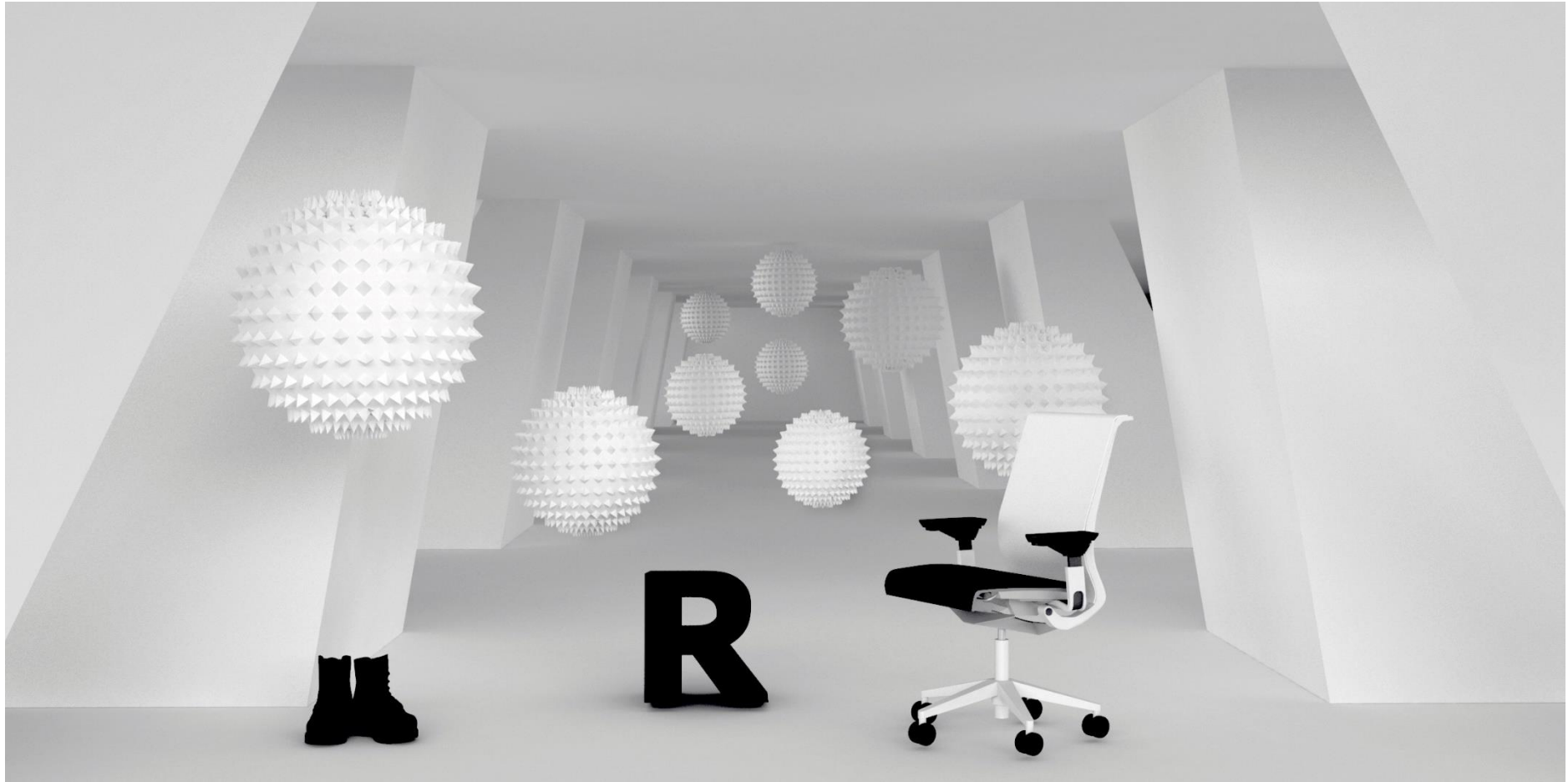




Assignment 1: Portfolio papers 1-3

Liya An 2005347 | RESILIENCE, TALENT AND TECHNOLOGY | 12nd September 2021

A Brief Introduction of the Differing Perspectives on Human-Cyber-Physical System and Employee Involvement in Industry 4.0

The implication of human-automation in Industry 4.0 towards HR practices

With the arrival of the fourth industrial revolution, beginning with industry 4.0, the buzzwords such as Internet of Things, cloud computing, and cyber-physical systems (Lu, 2017; Kagermann, 2015; Lasi et al, 2014; Kagermann, 2013) have been utilized in high-frequency in every line of work. At the employment levels, 'technological unemployment has become a threatening and fears due to the replacement of human labor force with automated productivity (Hislop *et al.*, 2017), even though OECD puts the figure of jobs that are vulnerable to automation at only 9 percent (Arntz *et al.*, 2016).

Prediction of decrease of the need for employee involvement resulting from automation has been challenged by a group of scholars who support a task-based analysis rather than job-based theory, asserting that human engagement will never be reduced because of new technologies (CIPD, 2017, p.10). Whether like it or not, human society has stepped into this technological era. The fact that the increasing need for interaction with machines and AI systems is impeding upon both customers and workers (Hislop, 2017) has raised challenges for modern organizations and called for rethinking and reinventing HRM and HR practices, such as job design in the future workplace. Put it differently, HR professionals have to understand the relationship between human participation and automated technologies if they intend to "be up the role and outgrown it" (Holley,2020) to date.

Three traditions regarding the employment/industrial relations

In the field of employment/industrial relations, Alan Fox firstly proposed three frames of reference, unitarist, pluralist, and radical frame that is called the "critical frame" today (1966,1974). The unitarist organization is characterized by unified/common management-worker interests and focuses on employee participation and involvement (Heerly, 2016; Wilkinson *et al.*, 2019). In a pluralist organization, employee participation focuses on negotiations by a democratic mechanism between employees and management to maintain a dynamic equilibrium of their conflicting interests (Kaufman *et al.*, 2021; Vereycken *et al.*, 2021; Herry, 2016). Critical organization, in contrast, the employee-management relationship cannot be reconciled because of their fundamentally opposed interests (Wilkinson *et al.*, 2019). In this tradition, employee involvement is observed and analyzed through antagonistic structures (Kaufman *et al.* 2021, p.7; Vereycken *et al.* 2021, p.50).

In parallel, three different perspectives in terms of employee involvement and technologies are defines as the techno-optimism, the socio-technical perspective, and the critical perspective (Vereycken *et al.*, 2021, p.51), among which the first two perspectives follow the unitarist tradition that highlights synergies between employee participation and managerial efficiency (Vereycken *et al.*, 2021, p.44).

Techno-optimism

Techno-optimism stresses human-centered design(semi-automation) which emphasizes operators' performance on interactive systems and their requirements within a collaborative industrial environment (Fernández-Caramés and Fraga-Lamas, 2018; Nelles *et al.*, 2016).

Human-centered smart systems (Reis, J., *et al.*, 2017; Sacha, D., *et al.*, 2017; Zhao, W., *et al.*, 2016; Lun and Zhao, 2015), under the industry 4.0 paradigm (Hermann, 2016) requires the connection among all the actors of the manufacturing chain, from machines to workers (Fernández-Caramés and Fraga-Lamas, 2018, p.25940). Furthermore, to handle the increasing complexity of interrelated and adaptive production processes, technology or automation should not displace operators because the strategy will dysfunction the full unleashing of the potential of the AI system (Wilson and Daugherty, 2018). Therefore, the concept of operator 4.0 has been induced into a cyber-physical system, which evolves into a so-called "human-automation symbiosis work system" due to human factors involved (Romero, *et al.*, 2016). This concept will be addressed in paper 2 in detail.

Socio-technical perspective

As a skill-oriented design concept, a socio-technical system is ‘an approach to work design that emphasizes the interactions and interdependencies between technology, humans and the organization as a whole (Kopp *et al.*, 2019, p.293). Before socio-technical methods and principles have succeeded, a series of frameworks with socio-technical mindset have been applied (Davis, 2014, p.5), such as Accimap (Rasmussen, 1997), the Human Factors Systems Analysis and Classification System (HFACS) (Wiegmann and Shappell, 2003), and Theoretic Accident Modelling and Process model (STAMP) (Leveson, 2004). But socio-technical systems theory proves to be a simple and effective analysis of the interconnected various elements within and outside the organization (Sony and Naik, 2020, p.5; Davis, 2014. p.7). The principles and methods help guide designers on an understanding of how new technologies can be utilized

and embedded within organizations as well as in existing social systems (Klein, 2005; Mumford, 1983).

Specifically, it contributes to widespread acceptance of socio-technical ideas, such as multi-skilling, user control, and autonomous workgroups (Grant *et al.*, 2011; Wall *et al.*, 1986), and mostly impacts on the ways of organizing work and the design of jobs (Davis, 2014, p.4). In a word, under the industry 4.0 paradigm, the full potential of the new technologies is determined by rethinking the roles of work and models of jobs in terms of technologies development and opportunities (Lall *et al.*, 2017; Kopp *et al.*, 2019). The German socio-technical perspective articulates the design principle should focus on team and job design which improves employees fully involved in the workplace and organization (Hirsch-Kreinsen, 2016). Team and job design should enable employees by providing them greater autonomy, decision-making power, and broad task content (Vereycken, Y., *et al.* 2021, p.55). While participatory design, a schema in which technical designers, workers, and stakeholders/users, collaborate to optimize the work community (Kohlgrüber *et al.*, 2019; Kaasinen *et al.*, 2019; Fischer and Senft, 2016). In a summary, the ultimate goal of socio-technical design methods is to combine and obtain effective and efficient production processes with an optimized working environment, creating a win-win situation for both employees and management (Morrar *et al.*, 2014)

Critical perspective

The critical perspective asserts the capital-labor relationship can be a 'positive-sum' relation, but its cooperation is under the condition of labor's disempowerment due to the conflicting/opposed interests (Edwards, *et al.*, 2006; Waschull *et al.*, 2017). The employees'

development and managerial control can never go to a balance only under the industry 4.0 paradigm (Butollo *et al.*, 2018). The authors embracing this approach highlight conditional participation and more managerial control in the workplace because the task content tends to be more standardized, which implies deskilling and simplification of work and the increase of restriction from the management (Cattero and D'Onfrio, 2018).

Socio-technical proponents proclaim industry 4.0 represents a division of Taylorism in the work and organizations, but critical theorists emphasize the continuation of applying standardization in the workflow to increase the control over the employees (Salento, 2018). They argue that industry 4.0 celebrates consolidating lean production standards, with technologies deteriorate the employee involvement practices (Buer, *et al.*, 2018; Butollo *et al.*, 2018)

In a word, critical perspective is quite different from techno-optimism and socio-technical theory regarding the understanding of industry 4.0 and pessimistic on the issue of impact from employee involvement upon the effectiveness and efficiency of the production process (Schiavo *et al.*, 2019).

Conclusion

In a summary, industry 4.0 assumes that economic, social or organizational issues can be solved by sorts of technologies (Morozov, 2013). All above three perspectives oppose technology determinism owing to its limited interpretation of industrial production processes. Those three perspectives make an endeavor to sway away from focus on technology exclusively and embrace employee involvement, which embodies the main characteristics of Industry 4.0. In

other words, they emphasize the human attributes involved in Industry 4.0 rather than exclusive smart technologies, which will definitely become a presupposition in the job design in the near future HR practices.

References:

Arntz, M., *et al.* (2016) 'The risk of automation for jobs in OECD countries: A comparative analysis', *OECD Social, Employment and Migration Working Papers No. 189*, Organization for Economic Co-operation and Development.

Buer, S.V., *et al.* (2018) 'The link between Industry 4.0 and lean manufacturing: mapping current research and establishing a research agenda', *International journal of production research*, 56(8), pp.2924-2940.

Butollo, F., *et al.* (2019) 'From lean production to Industrie 4.0: More autonomy for employees?', *Digitalization in Industry*, Palgrave Macmillan, pp. 61-80.

Cattero, B., and D'Onofrio, M. (2018) 'Organizing and collective bargaining in the digitized "tertiary factories" of Amazon: a comparison between Germany and Italy', *Working in digital and smart organizations*, Palgrave Macmillan, pp. 141-164.

CIPD (2017) *Impact of artificial intelligence, robotics and automation technologies on work*, Loughborough University.

Davis, M. C., *et al.* (2014) 'Advancing socio-technical systems thinking: A call for bravery', *Applied ergonomics*, 45(2), pp.171-180.

Edwards, P., *et al.* (2006) 'The bases of compromise in the workplace: A theoretical framework', *British journal of industrial relations*, 44(1), 125-145.

Ergonomics of Human-System Interaction—Part 210 (2010) ‘Human-Centred Design for Interactive Systems’, Standard ISO 9241-210, IOS, Geneva, Switzerland, Available: <https://www.iso.org/standard/52075.html> (Accessed: 23 August 2021)

Fernández-Caramés, T. M. and Fraga-Lamas, P. (2018) ‘A review on human-centered IoT-connected smart labels for the industry 4.0’, *IEEE access*, 6, pp. 25939-25957.

Fischer, H. and Senft, B. (2016) ‘Human-Centered Software Engineering as a Chance to Ensure Software Quality Within the Digitization of Human Workflows’, *Human-Centered and Error-Resilient Systems Development*, Springer, pp. 30-41.

Fox, A. (1966) ‘Industrial Sociology and Industrial Relations’, *Research Papers* 3, Royal Commission on Trade Unions and Employers’ Associations, London: HMSO.

Fox, A. (1974) *Beyond Contract: Work, Power, and Trust Relations*, London: Farber and Farber.

Grant, A. M., *et al.* (2011) ‘Work matters: Job design in classic and contemporary perspectives’, in S. Zedeck (ed.), *APA handbook of industrial and organizational psychology, Vol. 1. Building and developing the organization*, American Psychological Association, Available at: <https://doi.org/10.1037/12169-013> (Accessed: 23 August 2021), pp. 417–453.

Heery, E. (2016) *Framing work: Unitary, pluralist and critical perspectives in the 21st century*, Oxford: Oxford University Press.

Hermann, M., *et al.* (2016) ‘Design principles for industrie 4.0 scenarios’, In *2016 49th Hawaii international conference on system sciences (HICSS)*, IEEE, pp. 3928-3937.

Holley, N (2020) 'You can't put in what God left out', Available at: <https://gittemandrup.dk>
(Accessed: 23 August 2021)

Hirsch-Kreinsen, H. (2016) 'Digitization of industrial work: development paths and prospects', *Journal for Labour Market Research*, 49(1), 1-14.

Hislop, D., *et al.* (2017) 'Impact of artificial intelligence, robotics and automation technologies on work', CIPD Rapid evidence review, pp.10-11.

Kaasinen, E., *et al.* (2020) 'Empowering and engaging industrial workers with Operator 4.0 solutions', *Computers & Industrial Engineering*, 139, 105678.

Kagermann, H. (2015), 'Change through digitization—value creation in the age of Industry 4.0', *Management of Permanent Change*, Springer, pp. 23–45.

Kagermann, H., *et al.* (2013) 'Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0: Securing the Future of German Manufacturing Industry', *Final Report of the Industrie 4.0 Working Group*, Forschungsunion.

Kaufman, B. E., *et al.* (2021) 'Using unitarist, pluralist, and radical frames to map the cross-section distribution of employment relations across workplaces: A four-country empirical investigation of patterns and determinants', *Journal of Industrial Relations*, 63(2), 204-234.

Kohlgrüber, M., *et al.* (2019) 'A new innovation paradigm: combining technological and social innovation', *Matériaux & Techniques*, 107(1), 107.

Kopp, R., *et al.* (2019) 'Sociotechnical perspective on digitalization and Industry 4.0', *Technology Transfer and Commercialisation*, 16, pp. 290–309.

Lasi, H. *et al.* (2014) 'Industry 4.0', *Business & Information Systems Engineering*, vol. 6, Springer, pp. 239–242.

Leveson, N. (2004) 'A new accident model for engineering safer systems', *Safety Science*, 42(4), pp.237-270.

Lu, Y. (2017) 'Industry 4.0: A survey on technologies, applications and open research issues', *Journal of industrial information integration*, 6, pp.1-10.

Lun, R. and Zhao, W. (2015) 'A survey of applications and human motion recognition with microsoft kinect', *International Journal of Pattern Recognition and Artificial Intelligence*, 29(05), 1555008.

Morozov, E. (2013) *To save everything, click here. Technology, solutionism and the urge to fix problems that don't exist*, London: Penguin Books.

Morrar, R., *et al.* (2014) 'The fourth industrial revolution (Industry4.0): A social innovation perspective', *Technology Innovation Management Review*, 7, 3– 5.

Nelles, J, *et al.* (2016) 'Human-centered design of assistance systems for production planning and control: The role of the human in Industry 4.0,' *Proc. IEEE Int. Conf. Ind. Technol. (ICIT)*, Taipei, Taiwan, Mar. 2016, pp. 2099–2104.

Rasmussen, J. (1997) 'Risk management in a dynamic society: a modeling problem', *Safety Science*, 27(2-3), pp.183-213.

Reis, J., *et al.* (2017). Human-centered application using cyber-physical production system. In *IECON 2017-43rd Annual Conference of the IEEE Industrial Electronics Society*, IEEE, pp. 8634-8639.

Romero, D., *et al.* (2016) 'Towards an operator 4.0 typology: a human-centric perspective on the fourth industrial revolution technologies', *proceedings of the international conference on computers and industrial engineering (CIE46)*, Tianjin, China. pp. 29-31.

Sacha, D., *et al.* (2017) 'What you see is what you can change: Human-centered machine learning by interactive visualization', *Neurocomputing*, 268, pp.164-175.

Salento, A. (2018) 'Digitalisation and the regulation of work: theoretical issues and normative challenges', *Ai & Society*, 33(3), pp.369-378.

Schiavo, G., *et al.* (2019) '(Non -) Participation in deliberation at work: a case study of online participative decision - making', *New Technology, Work and Employment*, 34(1), pp. 37-58.

Sony, M. and Naik, S. (2020) 'Industry 4.0 integration with socio-technical systems theory: A systematic review and proposed theoretical model', *Technology in Society*, 61, 101248.

Ulrich, D and Smallwood, N (2021) 'HR's Reinvention: Moving from Benchmarking and Best Practices to Guidance', *The RBL Group*, 11th March, Available at: <https://www.rbl.net/insights/articles/hrs-reinvention-moving-from-benchmarking-and-best-practices-to-guidance> (Accessed: 23 August 2021)

Vereycken, Y., *et al.* (2021) 'Old wine in new bottles? Revisiting employee participation in Industry 4.0', *New Technology, Work and Employment*, 36(1), 44-73.

Wall, T. D., *et al.* (1986) 'Outcomes of autonomous workgroups: A long-term field experiment', *Academy of Management Journal*, 29(2), 280-304.

Waschull, S., *et al.* (2017) 'Impact of technology on work: Technical functionalities that give

rise to new job designs in industry 4.0', *IFIP International Conference on Advances in Production Management Systems*, Springer, pp. 274-281.

Wiegmann, D. A. and Shappell, S. A. (2017) *A human error approach to aviation accident analysis: The human factors analysis and classification system*, Routledge.

Wilkinson, A., *et al.* (2019) 'Toward an integration of research on employee voice', *Human Resource Management Review*, 30(1), 100677.

Wilson, H. J. and Daugherty, P. R. (2018) 'Collaborative Intelligence: Humans and AI Are Joining Forces', *Harvard Business Review*, Available at: <https://hbr.org/2018/07/collaborative-intelligence-humans-and-ai-are-joining-forces> (Accessed: 23 August 2021)

Zhao, W., *et al.* (2016) 'A human-centered activity tracking system: Toward a healthier workplace', *IEEE Transactions on Human-Machine Systems*, 47(3), pp. 343-355.

The Differences and Commonalities of ‘Techno-optimism’ and ‘Socio-technical perspective’

The first paper has outlined the theoretical framework of three perspectives, discussing the impact of various elements, especially human attributes in production process in the industry 4.0, which can be taken as the precondition to guide job design in the near future. The following discussion is trying to display the differences and commonalities of preferred perspective which could be the theoretical underpinning of the next third paper.

Critical perspective stresses the technologies offer many opportunities to management, not employees instead. This Tayloristic trend hampers employee involvement and the process of innovation because of the impact of command-and-control upon the workforce. This kind of managerial mindset is bound to be obsoleted (Johannessen, 2018, p.22). Techno-optimism and socio-technical perspective, focusing on a human-centered approach, both celebrate employee engagement and strive for the win-win scenario in labor-management relations.

No matter what concepts have been referred to, they intend to give industry 4.0 a "human", not a “technological” face instead (Vereycken, et al., 2021, p.58). In spite of the fact that the human workforce is "in the control loop" of industrial systems, a techno-centered approach just favors the allocation of tasks to automated and smart systems, only considering the human workforce at the end of the process of job design (Pacaux-Lemoine, 2017). In terms of techno-optimism, it initially highlights human factors in the job design, presupposing humans with magical capabilities engagement (Trentesaux and Millot, 2016), which have been drafted as the “Operator 4.0 typology” (Romero, 2016). Operator 4.0 targets enabling the operators with

proper technologies, systems, tools, and integrating the human, cyber, and physical worlds (Human-Cyber-Physical Work Systems), as well as tomorrow's hybrid, remote, on-site workplaces, and the so-called "home office" (Romero *et al.* 2021, p.152). Those collaborative and wearable technologies empower employees' daily work and involvement, effectively relieving mental and physical stress and allowing employees to develop their innovative skills with hands-free tools and real-time information to rise productivity (Romero *et al.*, 2016; Bernal *et al.*, 2017; Mart *et al.*, 2021).

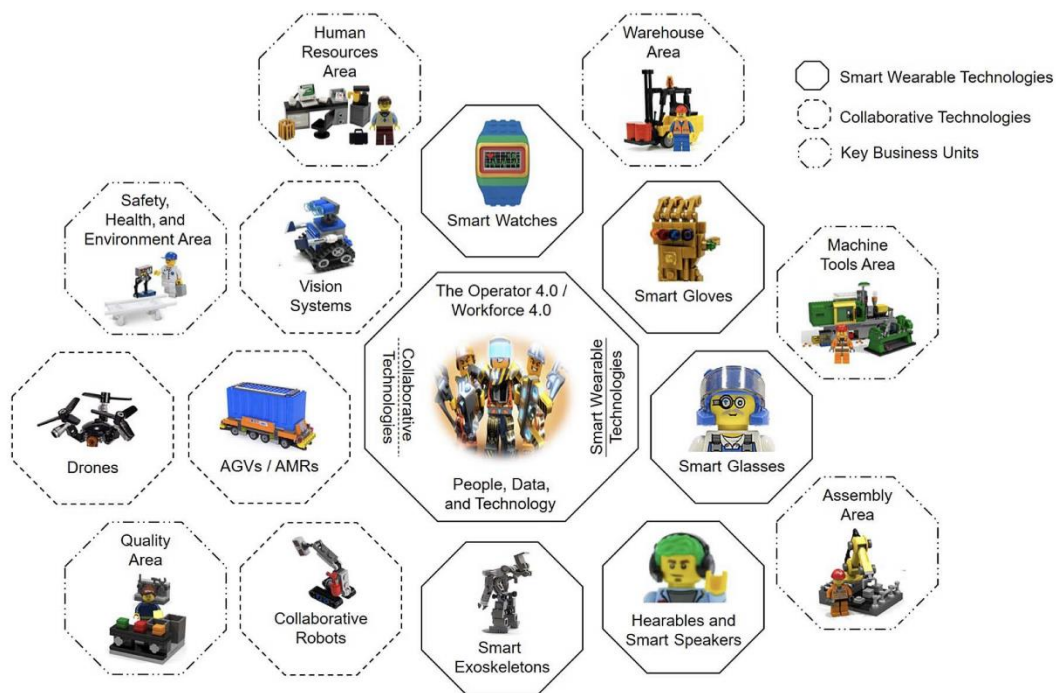


Figure 1: Sustainable and Smart Manufacturing System

(Source: Romero *et al.*, 2021)

In the parallel, one of the leading opinions of Industry 4.0 advocates people in the future will be employed as “more in the role of mediators of experience, as decision-makers and coordinators...[that is,] the variety of job content for the individual employee will increase”

rather than just “machine operators” (Hirsch-Kreinsen, 2016). Just like Sarcos CEO Ben Wolff said, "To err may be human, but it's really difficult to get a robot to be able to do all the kinds of analytics and decision-making that humans can do. There will always be an error, the fact is that there will be even more error if we were solely relying on AI" (GE Ventures, 2017). In other words, the preference for standardization and mechanization is helpful to lower uncertainty and avoid complexities of management (Gibbs, 2017, p.2), but robots, informants, and nano-computers are just a pile of procedures and software. Newer emerging and unpredicted behaviors and contexts call for human-cyber-physical symbiosis to handle the situation regarding human control and machine capabilities.

As for socio-technical perspective, this schema inclines to envisage a framework for analyzing the relationships and linkages between various elements both social and technical (Davis, 2014, p.6-7). Since the beginning of industrialization, machine-human collaboration has evolved from simple (with mechanization) to complicated (with computerization), and now complex (with semi/full automation) systems (Pacaux-Lemoine, 2017). On the other hand, with the emergence and development of Complexity science, the reductionist mindset has been disrupted and replaced by the theory that advocates inter-action and interrelationship of elements within a system and its environment (Mitleton-Kelly, 1997). Network science assumes that everything touches everything and it is not the individual parts that explain a phenomenon but the interconnectivity, which defines the system as a whole (Barabasi, 2014). In this context, Industry 4.0 can be taken as a socio-technical system (Sony and Naik, 2020).

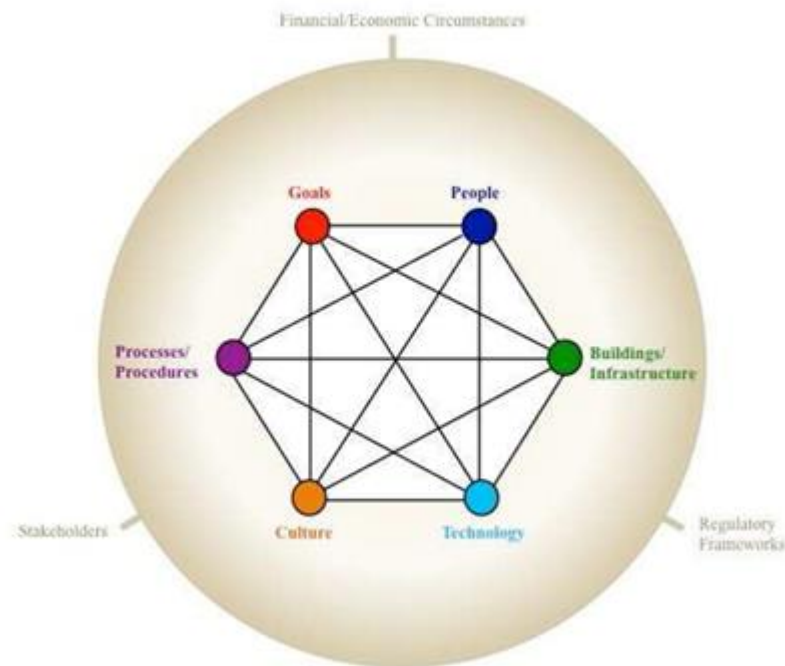


Figure 2: Socio-technical system (interrelated nature of the system and embedded within an external environment) (Source: Davis, 2014)

Thus, a working system, for example, will usually have a series of metrics and goals, involve employees (with diversified skills and attitudes), utilizing a set of tools and technologies, working and producing within an actual physical infrastructure, using a set of working practices and production processes, and operating with sets of cultural suppositions. Notably, the system sits in a wider context, integrating an economic/ financial environment, a regulatory framework, and a group of stakeholders (e.g. customers).

In a summary, the socio-technical perspective and human-cyber-physical work system based on the concept of operator 4.0 both stress the heterogeneity of tasks performed in the workplace. The future job design has to adopt a task-based rather than an occupation-based analysis (Arntz *et al.*, 2016). In other words, besides considering the human centricity and job autonomy, the

redesign of task structures has to set about broadening task content within a certain occupation because a job is bundles of tasks that differ within internal and external contexts where repetitive and routine tasks can be supplemented by hard-to-displace tasks, such as non-routine, manual, cognitive and social tasks (Gibbs, 2017; Arntz *et al.*, 2016).

Type of task	Attributes that are difficult to automate	Example
<i>Non-routine</i>	Complex; unpredictable; changing	Tax law; law enforcement; computer networking
<i>Manual</i>	Object recognition; mobility in unmapped space; fine dexterity	Sorting random objects; restaurant table service; surgery
<i>Cognitive</i>	Managing change; continuous improvement; creativity; innovation; abstract analysis	Organizational restructuring; total quality management; art; pharmaceutical research; economic theory
<i>Social</i>	Service; negotiation; teaching; collaboration; management/coordination; leadership	Nursing; sales; professor; orchestra performer; project management; CEO

Figure 3: tasks not susceptible to be automated (Source: Gibbs, 2017)

It is noted that smart machines are getting out of narrow definition and beginning to display broad capabilities in patterns of complicated communication and recognition. For example, machine and deep learning start to touch upon high-skill jobs that used to be exclusively human (Brynjolfsson and McAfee, 2016; Frey and Osborne, 2013). Nevertheless, machine designers and researchers will have a long way to go before they will be confident to answer the questions like how to develop machines regarding skills of non-linear problem-solving, adaptability, originality, deduction, and reasoning (Autor, 2015, p.5). For example, smart technologies are used to augment physicians' clinical judgment and expertise rather than to replace them shortly.

Disruptive technologies are changing the employee-employer relationship, but a jobless future has been denied because of task-based orientation and the certainty of involvement of employees. Machine and deep learning trends might further complement tasks rather than

automate them. But more studies are needed on how technologies and machine learning are implemented, and on how they complement or substitute different tasks, and the ultimate impact on job designs (Gibbs, 2017). Perhaps the idea of ‘job design’ could be ultimately given up and turn to agree on outcomes and goals and then enable employees to ‘design their work in response to the shifting context’ (Naomi Standford, 2018).

References:

Arntz, M. *et al.* (2016) The risk of automation for jobs in OECD countries: A comparative analysis, Working Paper No. 189, France: OECD Publishing.

Autor, D. H. (2015) ‘Why Are There Still So Many Jobs? The History and Future of Workplace Automation’, *The Journal of Economic Perspectives*, 29(3), 3–30.

<https://doi.org/10.1257/jep.29.3.3>

Barabási, A. L. (2014) *Linked: How Everything Is Connected to Everything Else and What It Means for Business, Science, and Everyday Life*, A Member of the Perseus Books Group.

Bernal, G., *et al.* (2017) ‘Safety++ designing IoT and wearable systems for industrial safety through a user centered design approach’, *Proceedings of the 10th International Conference on PErvasive Technologies Related to Assistive Environments*, pp. 163-170.

Brynjolfsson, E. and McAfee, A. (2016) *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, New York: W. W. Norton.

Davis, M. C., *et al.* (2014) ‘Advancing socio-technical systems thinking: A call for bravery’, *Applied ergonomics*, 45(2), pp.171-180.

Flower, J. (2019) 'New Technologies and the impact on Job Design', LinkedIn, Available at: <https://www.linkedin.com/pulse/new-technologies-impact-job-design-julia-flower/> (Accessed: 30 August, 2021)

GE Ventures (2017) 'This robot will give human workers superhuman strength (Sarcos) CNBC', Available at: <http://gev.jl.monkapps.com/news/robot-will-give-human-workers-superhuman-strength-sarcos-cnbc> (Accessed: 27 August 2021)

Gibbs, M. (2017) 'How is new technology changing job design?', *IZA World of Labor*, Available at: <https://wol.iza.org/articles/how-is-new-technology-changing-job-design/long> (Accessed: 27 August 2021)

Hirsch-Kreinsen, H. (2016) 'Digitization of industrial work: development paths and prospects', *Journal for Labour Market Research*, 49(1), 1-14.

Johannessen, J. A. (2018) *The workplace of the future: The fourth industrial revolution, the precariat and the death of hierarchies*, CRC Press, Available at: <https://www.taylorfrancis.com/books/oa-mono/10.4324/9780429441219/workplace-future-jon-arild-johannessen> (Accessed: 27 August 2021)

Kaasinen, E., *et al.* (2020) 'Empowering and engaging industrial workers with Operator 4.0 solutions', *Computers & Industrial Engineering*, 139, 105678.

Mark, B. G., *et al.* (2021) 'Worker Assistance Systems in Manufacturing: A Review of the State of the Art and Future Directions', *Journal of Manufacturing Systems* 59, pp. 228–250, Available at: <https://doi.org/10.1016/j.jmsy.2021.02.017> (Accessed 28th August 2021)

Mitleton-Kelly, E. (1997) "Organisations as Co-evolving Complex Adaptive Systems", *British Academy of Management Conference*.

Naomi Standford (2018) 'job design', Available at:

<https://naomistanford.com/2018/06/05/job-design/> (Accessed: 31 August, 2021)

Pacaux-Lemoine, M. P., *et al.* (2017) 'Designing intelligent manufacturing systems through Human-Machine Cooperation principles: A human-centered approach', *Computers & Industrial Engineering*, 111, pp.581-595.

Romero, D., *et al.* (2016) 'Towards an operator 4.0 typology: a human-centric perspective on the fourth industrial revolution technologies', *proceedings of the international conference on computers and industrial engineering (CIE46)*, Tianjin, China. pp. 29-31.

Romero, D., *et al.* (2021) 'Smart Wearable and Collaborative Technologies for the Operator 4.0 in the Present and Post-COVID Digital Manufacturing Worlds', *Smart and Sustainable Manufacturing Systems*, 5(1), pp.148-166.

Sony, M. and Naik, S. (2020) 'Industry 4.0 integration with socio-technical systems theory: A systematic review and proposed theoretical model', *Technology in Society*, 61, 101248.

Trentesaux, D. and Millot, P. (2016) 'A human-centered design to break the myth of the "magic human" in intelligent manufacturing systems', *Service orientation in holonic and multi-agent manufacturing*, Springer, pp. 103-113.

Vereycken, Y., *et al.* (2021) 'Old wine in new bottles? Revisiting employee participation in Industry 4.0', *New Technology, Work and Employment*, 36(1), 44-73.

Paper 3: The Discussion on Job Design of Literature Translation production of Chinese Web-novels under Human-Cyber-Physical System in the Future

The human-centricity and socio-technician perspective can be the rationale of my research which is trying to discuss the emerging web-novel markets and the influence of technologies upon the work practices of practitioners of translating. The research target is Funstory.ai Technology (Beijing), an artificial intelligence technology company. According to the report of IResearch consultant company in 2020, Funstory.ai Technology (Beijing) was established in 2017. It targets to explore the first self-developed artificial intelligence translation production network in the field of literature worldwide, providing web-novel companies with one-stop service from zero-cost translation production to global multilingual distribution and monetization of digital publishing, and empowering the entire industry through artificial intelligence. Most importantly, the current AI machine designed by Funstory.ai can automatically monitor, capture, translate and publish Chinese novels from the whole network without a manual review process, which improves the efficiency of the industry by 3600 times (it takes human translators 1 hour to translate 1000 words, but only 1 second for AI), and reduces to 1/100 of the original cost of the labor force (Human workers need to be paid RMB 100,000 yuan for translating 1,000,000 characters, but AI is paid only 1000 yuan for translating the same amount of characters) (36Kr, 2018). The CEO of Funstory.ai, Xie Tong said, in the advent of the era of AI, the machine began to understand all the things that go beyond those that are developed and designed in the industrial era, such as empathy, sacrifice, and sentiment (Li, 2018). On the contrary, some scholars believe that strong AI exists hitherto only in sci-fi fiction and movies (Hislop, 2017, p.6), weak AI can only complete repetitive and routinized

tasks, but can never replicate human's mindset and the way of thinking (Hengstler, 2016). Besides, the German government launched the "Work 4.0" discussion in 2015, which advocates individual flexibility and standard employment relationships when it comes to Industry 4.0 (Salimi, 2015). The previous two papers provide a theoretical underpinning to justify that Industry 4.0 implies a paradigm to the work design which highlights interconnectedness and interactions within. In other words, in the Fourth Industrial Revolution, a 'complementary' job design is stressed rather than a dichotomy of 'either individual or the technologies' (Kopp, *et al.*, 2019, p.293).

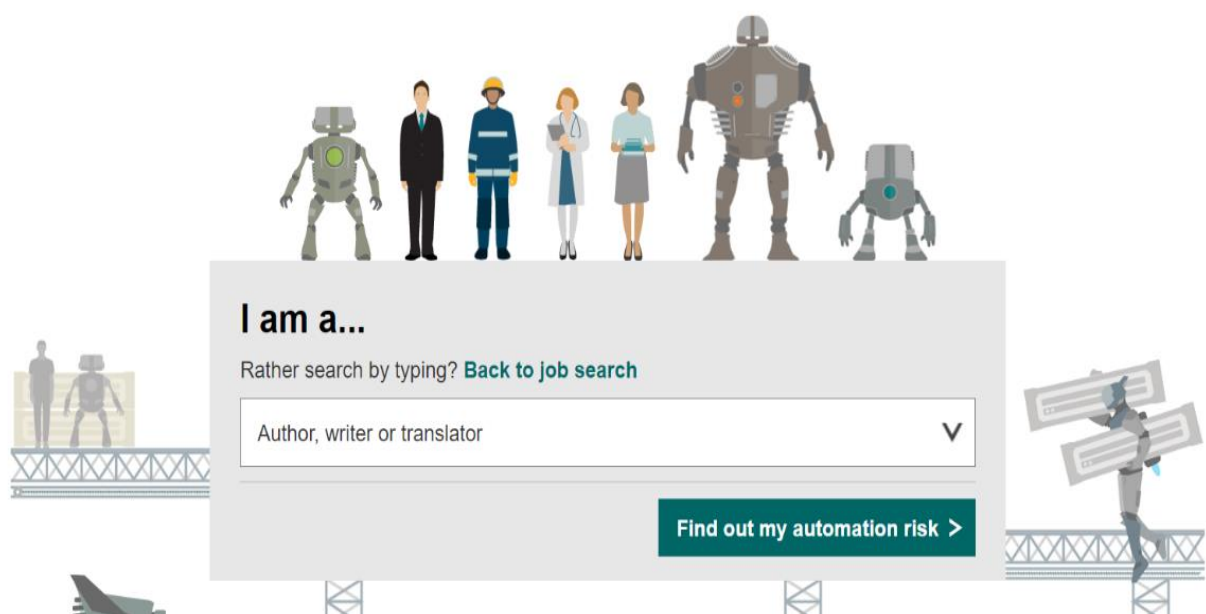
Will a robot take your job?

🕒 11 September 2015



Type your job title into the search box below to find out the likelihood that it could be automated within the next two decades.

About 35% of current jobs in the UK are at high risk of computerisation over the following 20 years, according to a study by researchers at Oxford University and Deloitte.



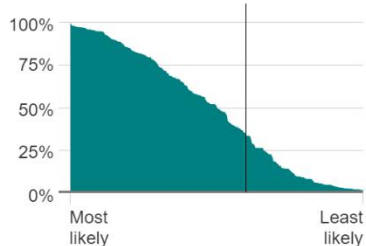


Authors, writers and translators

Likelihood of automation?
It's not very likely (33%)

How this compares with other jobs:

220th of 366

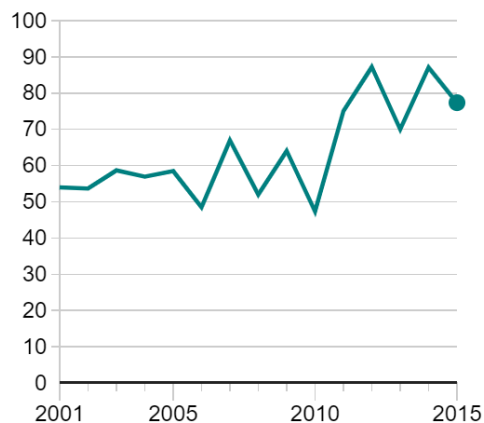


[Share my result](#)

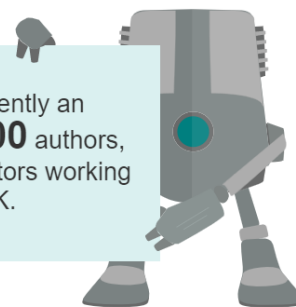


Your job in 2015

Number employed in thousands



There are currently an estimated **77,000** authors, writers and translators working in the UK.



£26,642

Average full-time salary for authors, writers and translators in 2014

£27,195

UK average full-time salary (all jobs) in 2014

Figure 3: Will a robot take your job? (Source: BBC News website)

The survey of BBC asserts translators' tasks and works that demand cognitive capabilities are among the list of jobs that are less likely replaced by robots (2015), while Funstory.ai claims that AI can develop mimic cognitive capabilities, understand human language, and independently operate the translating practices, and thus makes the productivity soaring.

The achievement of Funstory.ai Technology is stunning. In the live event of the 3rd Network Literature + Conference of China, the real-time "duel" between the AI translation system developed by this company and foreign readers turned the audience upside down (Funstory.ai, 2020). It is an unbelievable scenario concerning disruptive technologies that are bound to catch the researchers' attention. Thus, the research questions can be designed as the following:

1. How likely translators will be replaced by robots?
2. To what extent the jobs of translators can be complemented or substituted by algorithms and machines?
3. How to embed this cyber-physical system into translators' jobs in the production process of web novels to overseas readers and consumers?
4. How do those readers of web novels translated by AI feel in the process of reading?
5. How to improve both the work experiences of translators and the reading experiences of consumers/readers?

According to the definition of job design, it is "a process undertaken to realign tasks assigned to job roles; to ensure jobs reflect the current organization business operations and are meaningful and engaging" (Flower, 2019). Furthermore, with the paradigm shift, a fit system

that focuses on cost savings and efficiency has transferred to human operators which centers on the resilience and creativity of human employees (Kaasinen, *et al.*, 2020), e.g. employee involvement. Henceforth, the job design of employees of translation text production in the future is all around translators' work experiences(satisfaction) and customers' reading experiences. For part of work satisfaction and engagement, employee preference-based workflow and scheduling algorithms support resilience and adaptability of human-cyber-physical work system (Colucci et al., 2004; Jaturanonda and Nanthavanij, 2011). On the other hand, to make regular survey and observation on messages from customers community has to be included in translators' task in the future. the explicit feedback from readers is vital to improve the effectiveness of Human-machine cooperation because consumers' involvement and attachment to web-novels is golden criteria to the quality of the products.

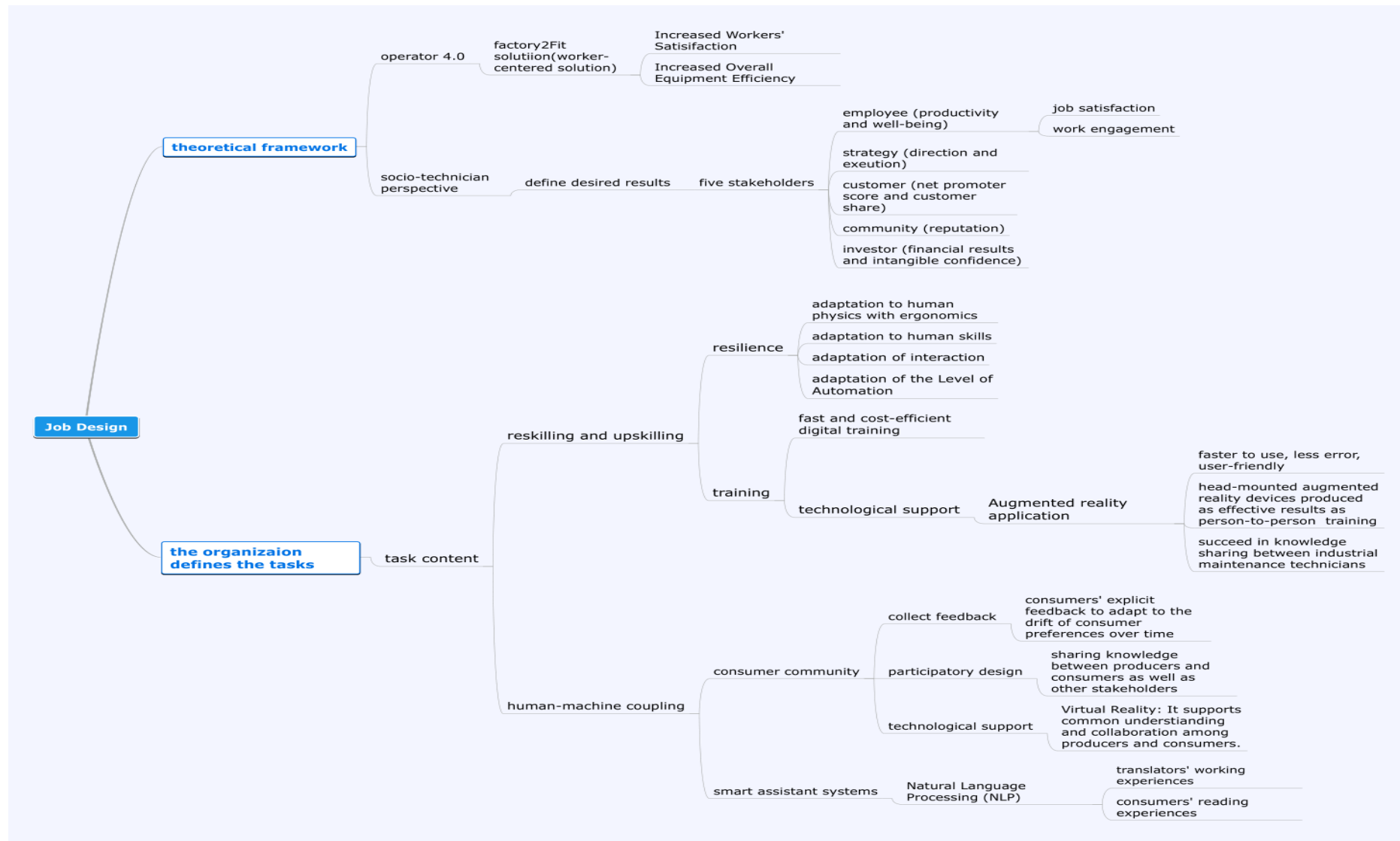


Figure 4: Conceptual Framework (Source: Chen *et al.*, 2012; Factory2Fit, 2019; funstory.ai ,2020; Ulrich, 2021)

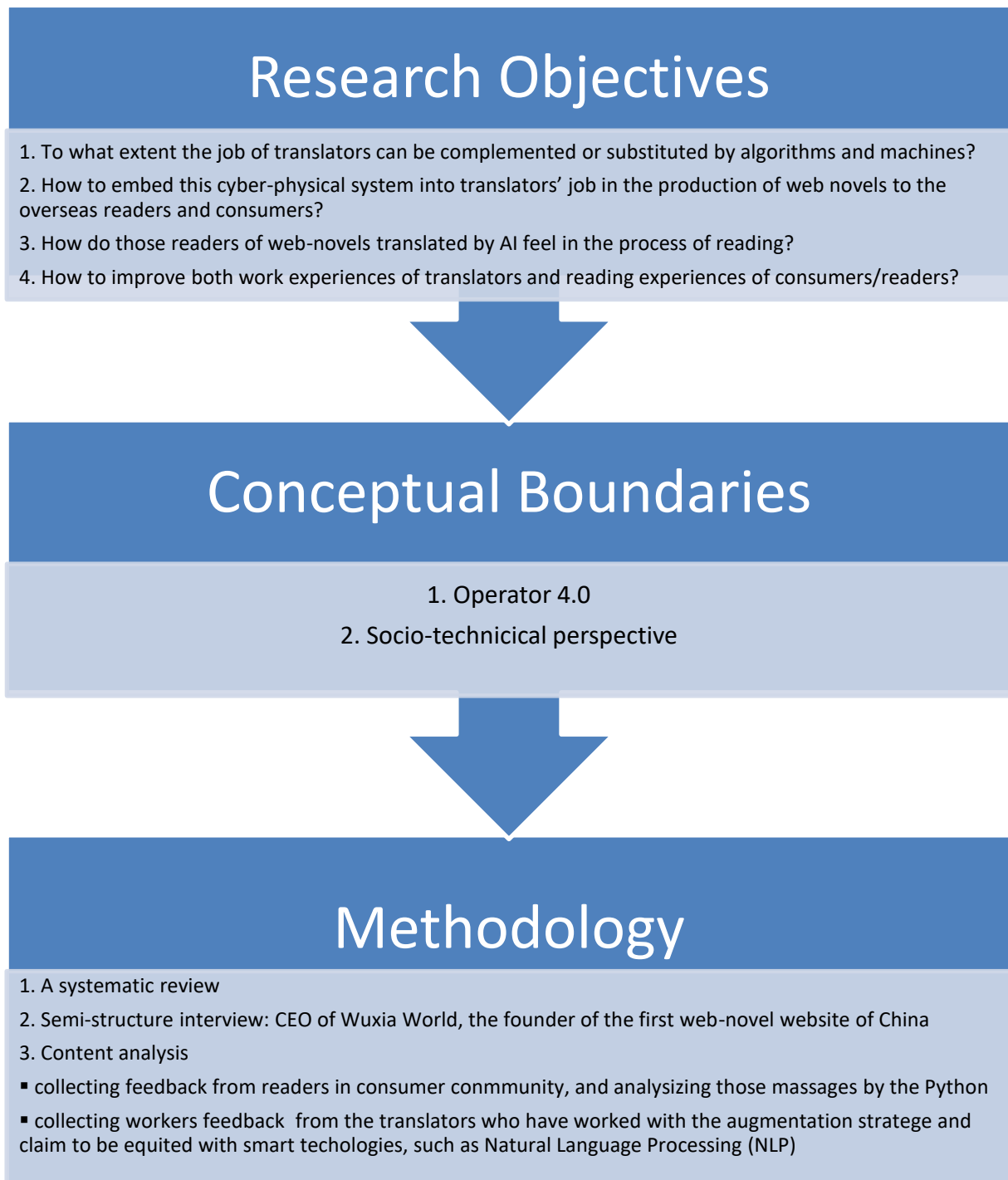


Figure 5: Research Design Protocol

For enhancing competitive advantages, Tong Ye, the CEO of funstory.ai said that in addition to AI translation technology, their core competitiveness lies in the construction of a web-based business system that covers the entire process of production, distribution, and monetization.

The translation of a novel requires the assembly of many content elements. The assembly process requires smooth collaboration with the AI translation engine (2020), which is not easy to do and demands further consideration to redesign tasks assigned to job roles. Furthermore, the most important purpose of this job design has to consider, except for enabling translators by virtue of augmentation strategy and smart technologies, how to cultivate and nurture people, as well as how to integrate technological and digital resources with humanity.

References:

36Kr (2018) 'Human translators can't keep up with the speed of foreign fans who follow Chinese online novels', 7th December, Available at: <https://36kr.com/p/1723033862145> (Access: 7th September 2021)

BBC News (2015) 'Will a robot take your job?', 11 September, Available at: <https://www.bbc.com/news/technology-34066941> (Accessed: 2nd September 2021)

Chen, T. Y., *et al.* (2012) 'Model-based development of user-centric automation and assistive devices/systems', *IEEE Systems Journal*, 6(3), 388-400.

Colucci, S., *et al.* (2004) 'Semantic-based Approach to Task Assignment of Individual Profiles', *Journal of Universal Computer Science*, 10(6), 723-730.

Factory2Fit (2019) *The Factory2Fit project: Work-centered Solution for the Factories of the Future*, Available at: <https://factory2fit.eu/> (Accessed: 7th August 2021)

Flower, J. (2019) 'New Technologies and the impact on Job Design', *Linkedin*, Available at: <https://www.linkedin.com/pulse/new-technologies-impact-job-design-julia-flower/> (Accessed: 8th September, 2021)

funstory.ai (2020) 'AI translation technology escort web-novels to go overseas: manual

translation, 1 hour, smart translation, 1 second'. 4 June. Available at:

<https://funstory.ai/2020/06/04/> (Accessed: 8th September 2021)

funstory.ai (2020) 'Funstory. ai Technology receives tens of millions of RMB in A+ round of financing, using AI to accelerate the scale of online literature to go overseas'. 3 September.

Available at: <https://funstory.ai/2020/09/03/https-36kr-com-p-860221625473417/> (Accessed: 9th September 2021)

Hengstler, M., *et al.* (2016) 'Applied artificial intelligence and trust: the case of autonomous vehicles and medical assistance devices', *Technological Forecasting and Social Change*, 105, pp105–20.

Hislop, D., *et al.* (2017) 'Impact of artificial intelligence, robotics and automation technologies on work, *CIPD Rapid evidence review*.

IRearch (2020) 中国网络文学出海研究报 Overseas Business Research Report of Chinese Web-novel Companies, Available at: <http://report.iresearch.cn/wx/report.aspx?id=3644> (Accessed: 7th September 2021)

Jaturanonda, C. and Nanthavanij, S. (2011) 'Analytic-based decision analysis tool for employee-job assignments based on competency and job preference', *International Journal of Industrial Engineering: Theory, Applications, and Practice*, 18(2).

Kaasinen, *et al.* (2020) 'Empowering and engaging industrial workers with Operator 4.0 solutions', *Computer & Industrial Engineering*, 139, 105678.

Kopp, R., *et al.* (2019) 'Sociotechnical perspectives on digitalisation and Industry 4.0', *International Journal of Technology Transfer and Commercialisation*, 16(3), pp. 290-309.

Li, R. Y. (2018) 'China encourages pushing the business of web-novels to go overseas under

the help of AI, how this company complement this strategy?', 9th October, Financial Times, Available at: <http://www.ftchinese.com/interactive/24644?exclusive> (Accessed: 7th September 2021)

Salimi, M. (2015) 'Work 4.0: An enormous potential for economic growth in Germany', *ADAPT Bulletin*, 16.

Ulrich, D. (2021) 'HR's Reinvention: Moving from Benchmarking and Best Practices to Guidance', 31th January, *Best Practice in Human Resources*, Available at: <https://www.bestpracticeinhr.com/hrs-reinvention-moving-from-benchmarking-and-best-practices-to-guidance/> (Accessed: 7th August 2021)