Avoiding the OEM Vs OED Conundrum in 'Make In India' Through Science-Fiction Prototyping

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Abstract: *This paper addresses a scenario that can unravel for the 'Make in India' program as a consequence of vulnerabilities seen in manufacturing-based economies in a globalized world, especially when a transition from the Fourth Industrial Revolution to Fifth Industrial Revolution is taking place. Subsequently, it proposes a Science-Fiction Prototyping-based pedagogy to be deployed in NEP's flipped classroom as a risk-management strategy. The authors believe that such a strategy would help Indian manufacturing-sector to mature early, as well as assuage the emotional anxieties of its young workforce that is eager to find its place in the supply chains of the world.*
Keywords: *Make-in-India, Fifth Industrial Revolution, Design Fiction, Science-Fiction Prototyping, NEP 2020, Flipped Classroom*

INTRODUCTION:

'Make in India' has been in mainstream political discourse since 2014. Prime Minister Narendra Modi gave a call for it on August 15th, 2014 as a means to not only contain India's Current Account Deficit, but also to create more jobs in the manufacturing sector which, owing to the sector being technology- and capital-intensive, had historically been a laggard in the Indian economy. Most importantly, since realpolitik has legitimized the weaponization of trade to pursue geopolitical interests in the recent years (Pathak, 2018), local manufacturing has been deemed as strategically important, especially in critical sectors such as semi-conductors, synthetic raw materials, and defence. Hence, many policy decisions have been taken up by the Government of India and various state governments in the realm of infrastructure development, labour laws, environmental clearances, etc. (Mehta, Rajan, 2017) to boost/support domestic manufacturing of various types of goods, systems and sub-systems, and pave way for India to realize the goal of becoming a 5 trillion-dollar economy (Pradhan, Aggarwal, 2020).

However, in all the noise surrounding 'Make in India', the following points need to be kept in mind since these would be the eventual challenges that India, or any other manufacturing nation, would have to face. To begin with, implicit within the call to 'Make in India' is a focus on making India an OEM hub, rather than an ODM hub. For the uninitiated, OEM means Original Equipment Manufacturer/Manufacturing, and ODM means Original Design Manufacturer/Manufacturing. In order to shake up the established supply chain that is centred in various export-oriented economic zones in India's neighbour, the Indian policy-makers have been actively promoting India as a more reliable and ethical manufacturing hub of original designs/equipment to different corporations of the world. At the heart of this pitch is the guarantee that India is willing to provide to safeguard the intellectual property/proprietary technology of OEM/ODM corporations (Chaudhary et al, 2020) once they have relocated their factories to India from nations where blatant violations of IPR takes place on a regular basis (Brander et al. 2017, Muehlfeld, Wang, 2022). However, and despite flagrant IPR violations, it is becoming increasingly evident that such a relocation will be a long-drawn-out process. Reasons cited for this slow pace include the quality of workforce, prevailing labour and environmental laws, and inadequate infrastructure. In fact, owing to the absence of a robust domestic ecosystem that can produce all sub-systems needed for manufacturing of the finished OEM products, big manufacturers are thinking twice before coming to India. The prospect of importing sub-systems from abroad and assemble the final product in India, thus, leaves the sector vulnerable to disruptions caused in the back-end of the supply-chain, as was seen in the recent chip-shortage episode that affected the auto-sector or the delay in engines and other sub-systems for India's Tejas Mk1A aircraft. There are additional critical concerns in this trajectory of economic growth, due to which we need to be wary of becoming an OEM hub for the long term. First, the fundamental characteristic of Capitalism in a globalized economic order is that it only cares about procuring products/commodities at the cheapest price. For the parent companies that own the intellectual property

rights to the OEM products, it does not matter whether the production facilities are located in India, Philippines, Malaysia, Turkey, Bangladesh, Mexico or other such nations till the time the quality and cost of the product is as per desired levels. They would not hesitate in shifting production facilities to other countries if profit margins become strained beyond acceptable levels due to any factor whatsoever. Hence, guaranteeing the safety of OEM's intellectual property rights would not sustain as a convincing pitch for inviting the relocation of manufacturing facilities to India in the long run. Further, it has been found out by numerous multi-national corporations that dis-entangling of supply chains is easier said than done (Kratz, Boullenois, 2023). Even if it is argued that setting up manufacturing facilities in India is viable since there is enormous un-met domestic demand, India cannot become a 5-trillion-dollar economy by exclusively manufacturing for this domestic market. It would always have to aim for becoming a net exporter in order to grow its economy and raise the standard of living of its huge population.

Secondly, and as was anticipated in the future visions of early science-fiction works, the thrust in the Fourth Industrial Revolution (Industry 4.0) is to make OEM production lines automated. Production lines that stop only to address breakdown/repair issues, don't come with the financial liabilities associated with hiring, training, healthcare, severance, retirement, etc. of a human workforce, and maintain a uniform quality in production have been actively developed in order to speed up the rate of production (Hajduk, Koukolová, 2015, Bahrin et al., 2016, Karabegović, 2018). Such automation has been introduced in industrialized nations such as South Korea, USA, Japan, Germany, Singapore, China, etc. in order to sustain the high levels of production that drives their economies. In fact, steady efforts are being made to increase the number of industrial robots per 10000 workers (World Robotics Report, 2023). Current trends in Industry 4.0 aim to realize greater efficiency in the use of resources through amalgamation of artificial intelligence, deep machine learning, and Internet of Things in order to drive industrial automation. India has only recently embarked on this journey. The SAMARTH (Smart Advanced Manufacturing and Rapid Transformation Hub) Udyog Bharat 4.0 was recently set up under the aegis of the Ministry of Heavy Industry & Public Enterprises, Government of India (GoI), in order to set up demonstration and experiential centres to spread awareness about Industry 4.0 amongst Indian manufacturers (SAMARTH Udyog, n.d.). It should not come as a surprise that Indian policy-makers' desire to make Indian manufacturing competitive in the international supply-chain by addressing technological obsolescence as well as to align themselves with global best practices and automate manufacturing facilities can jeopardise the promise of employment opportunities in the manufacturing sector. Pending financial feasibility of creating a fully-automated production lines, the human workforce would be either phased out of manufacturing or reduced to the level of low-skill assembly. This is a cause of concern for India since the pitch for 'Make in India' being the catalyst for job-creation for the Indian youth has occupied central place in the political rhetoric for the present government.

In view of the above emerging systemic challenges, a prudent course of action for Indian policy-makers would be to create a hedge position. In fact, along with policy-makers it is the student community in Indian educational institutions, whose 'demographic dividend' India is poised to reap ("India@100: Reaping the Demographic Dividend", 2023), who would have to actively participate in creating this hedge position. Their initiatives is also crucial since a major segment of this community comes from the aspiring and middle class. Their 'defined' career goals have been to acquire skills that help them find their place in the service sector and the new OEM production chains being set up in various states of India so that they not only recover the cost of their higher education but are also able to earn enough to realize their life/social/familial objectives. Keeping this in mind, the GoI already launched the 'Skill India' campaign in order to support its 'Make in India' mission. Under this it set up the National Skill Development Policy 2009, National Skill Development Fund (NSDF), National Skill Development Corporation (NSDC), National Skill Development Authority (NSDA) and National Skill Qualification Framework (NSQF). These institutions aimed to setup the necessary framework to impart skills that will be relevant in the emerging sectors in manufacturing (e.g.). However, the hedge position against the logical direction of capitalist development of manufacturing as enumerated above, would have to entail parallelly working on the second aspect of manufacturing—OED, or Original Equipment Design. As the name suggests, OED pertains to designing Original Equipment. This capability entails envisioning the idea/concept of a technology that solves a pertinent problem, converting it into a technology-product which can be fine-tuned before being moved to production lines for manufacturing for the consumer market. Clearly, and

while focus on original equipment manufacturing is necessary for providing jobs in the near future, it is the ability to anticipate and address the problems of the future which would keep the human element relevant in the manufacturing sector of the future, despite all the automation taking place around. A future scenario in which students find that their skill sets have proven to be woefully inadequate in finding them a place in the OEM lines being setup as per Industry 4.0 vision will be an unpalpable one. It comes as a relief that developing design capabilities won't entail inculcating a new set of skillsets since this can be drawn out from the skill-sets deemed relevant for manufacturing roles in Industry 4.0 (WEF 2016). The Industry 4.0 skills relevant to OED capabilities include "critical thinking, design thinking, creativity, sustainability" (Chenoy, 2019). However, it has been highlighted that the acquisition of these skills will require a "generational transformation" in higher education institutions, vocational education and skill-development ecosystem (Chenoy et al., 2019). Courses and course-delivery would have to be revamped in order to impart these skills. This paper intends to propose Science-fiction Prototyping as the academic tool that can rejuvenate the course-delivery mechanism in place in higher education institutions, and which will facilitate the cognitive leap to design original equipment, to both India's policy-makers and the teacher-learner community.

Science-fiction Prototyping: Design Thinking Evolved

Design Thinking has been broadly defined as a user-centred approach of problem-solving and innovation (Harvard Business School, n.d.). Design Thinking replaces the time-taking and cost-intensive method of developing a physical prototype by imagining and cognitively developing the technological prototype (Cross, 1982). It involves the following five stages: Empathize, Define, Ideate, Prototype and Test (Dam, 2024). Empathizing aims at understanding the human-centred assumptions and needs at the heart of the chosen problem. The various elements of the environment in which end-users live are analysed so that a better understanding of both the user as well as their needs can be gained. This knowledge is used to define the salient aspects of the prototype to be developed. These definitions, subsequently, help in ideation of the features, functions and other aspects of an imagined prototype solution that users could be looking forward to in order to simplify their everyday lives. Crucially, since prototype-development is costly and time-consuming, it is best that the process of ideation is rigorous in analysing all aspects of the proposed prototype. This means that it will not only look at the prototype from an engineering-perspective, for which digital tools abound. Rather, it would develop the prototype from the perspective of the end-user, in order to foresee the levels of acceptability, and limitations of the prototype that need to be overcome before the prototype is deemed as ready for shifting to the production line. Over the years, the process of Design Thinking has become a vital accessory to the digital design processes that characterize the Third Industrial Revolution. It is deemed an accessory because it does not result in an actual physical prototype of a new product. Rather, Design Thinking helps in understanding the needs of people, and deploys that knowledge in the process of ideation/conceptualization of that product, making product research and development cost-effective (Tschimmel, 2012, Castellion, Markham, 2013, McKinsey, 2015, Brenner, Uebernickel, 2016). Most importantly, the participatory approach in designing the product/service helps in realizing major intermediate outcomes (Jaskyte, Liedtka, 2022). The outcomes most relevant for the Indian society include psychological empowerment, overcoming cognitive biases, and inculcation of positive psychology. End-users feel psychologically empowered when they are consulted in the ideation process of the product that they will use. The collaborative effort involving other designers, engineers, marketing team, administrators, etc. helps in overcoming the cognitive biases that exist between different disciplines/departments. The process of wider consultation, deliberation and feedback makes all participants feel that they belong, resulting in positive psychology across the board. Clearly, India needs to work a lot on accelerating the pursuit of and consolidating the gains of these intermediate outcomes in order to take assured steps towards realizing the goal of becoming a 5-trillion-dollar economy that it has set for itself in the years to come. This need has been recognized in India now and leading technical educational institutions are developing courses centred around Design Thinking. However, it has been observed that these add-on courses are expensive and are (mostly) targeted at professionals. Students who come from a middle-class background would find the additional financial burden of such courses difficult to bear. Due to this, they will postpone the taking of such courses to a later stage in their professional life. Even professionals will pursue them only if these courses are deemed by their HR Department as 'up-skilling' and, hence, relevant for growth in their career. Thus, and while an effort has been made in the right direction, there is no guarantee that such courses will find wider

traction. Such limitations could be avoided if these courses are introduced early, either as part of compulsory academic curriculum or an add-on course. Further, the right academic tool would be needed in order set Indian students on the path of this cognitive development. Science-Fiction Prototyping is being proposed as that valuable, inexpensive tool to facilitate the pursuit of Design Thinking goals by integrating it in the teaching-learning process.

Science-fiction Prototyping (SFP) was heralded by Intel futurist Brian D. Johnson. SFP is quite distinct from science-fiction literature. Even though science-fiction has been deemed as the "most visible and influential form of futurist thinking in contemporary world" (Lombardo, 2015), as the genre most suited for creative imagining of possible futures (Csicsery-Ronay, 2008; Lombardo, 2006, 2015), having inspired many technological innovations (Bina et al., 2017, Jordan et al., 2018), it does not go unnoticed that the author's imagination does not know any boundaries in the story worlds of science-fiction literature. Narrative arcs in these works can, thus, be chronologically/spatially far-removed from the contemporary worlds of the readers. Further, this story world is characterized by a novum—a new device or machine whose presence facilitates the reconceptualization of the world in a different way (Suvin, 1972). Interestingly, there isn't any compulsion on the author to make this novum scientifically accurate and/or technologically plausible. In fact, many authors even resist the demand to ground this novum in either scientific or technological 'reality', resulting in the genre being rechristened as "fantasy". Even when authors include science and technology, they push them to the background and used the genre to give an oblique commentary upon contemporary issues of socio-political concern (Roberts, 2002), resulting in today's oft-used label for the genre—speculative fiction. On the contrary, SFP stories are centred around a radical technology prototype premised upon contemporary research and development of various technologies, and whose introduction would resolve important human problems (Johnson, 2011). SFP story worlds are located in the near future (not exceeding ten years from 'today'). Most importantly, SFP narrative focuses upon the nature of interaction between the technological prototype, the user(s) and the elements in the user's environment.

SFPs are also distinct from Design Fiction, the literary outcome of Design Thinking. Design Thinkers develop questionnaires and use close observation of possible end-users in order to design their scenarios. On the contrary, SFP authors draw up on various tropes that have been used over extended period of time in science-fiction novels, graphic novels and films (except the trope of distrust of technology), in order to construct the future scenarios in which technological prototypes are to be placed and tested. This is made possible by the fact that despite a lot of science-fiction literary works dealing with 'fictional' science (Roberts, 2002), there are many whose technologies are shaped by science 'facts' that operate in the realm of industrial design (Woodhouse & Patton, 2004). Such science-fiction works also demonstrate a systems-oriented approach in the construction of their story worlds (for e.g., Michael Crichton's Jurassic Park), allowing readers to understand the inter-relatedness and inter-dependence between various elements of the world that the protagonist/reader inhabits, and which would be transformed by the introduction of the new technology. SFP adopts a similar approach. For the ideation process, it draws inspiration from various elements of established designs, technologies and/or research. Subsequently, it carefully extrapolates these elements into the near future in order to explore what forms/iterations they can manifest into. Subsequently, SFP authors draw up prototypes of these iterations. While science and engineering researchers have already found this method extremely useful in exploring what technologies will be relevant in the near future (Kymalainen, 2016), the importance of the human aspect of the narratives highlights the relevance of 'experts' from other disciplines. In order to fully explore the nature of all possible 'interactions' between the prototype and its end-users, SFP authors would have to draw upon ideas from disciplines other than engineering in order to generate these insights. Thus, SFP writing was proposed as a collaborative effort, pushing developers to dismantle the boundaries that exist between respective disciplines. This begins with literature, since SFP requires drawing upon various narrative elements from science-fiction works (such as plot, characters, situations, conflicts), modify and/or recombine them in order to create newer story worlds, in which the prototypes can be placed and 'tested'. Other classical disciplines such as Political Science, History, religion, etc. provide the broader framework within which human needs are discussed and shaped, while modern disciplines such as behavioural sciences, cultural, ethnic, gender, urban, climate studies, etc. allow for more contemporary insights into human society. Only with a balanced combination of their inputs will generate narratives that will,

subsequently, provide crucial insights into "inflection" points ushered in by these technological prototypes in the human world (Johnson, 2010). This laborious pre-writing exercise is crucial since knowing the nature of these "inflection" points will reveal the level of acceptability for the radical technology, and/or the shortcomings in the prototype. In this way, SFP narratives function like user-trials but without involving a physical technological prototype or actual users. More accurate 'feedback' can be gained by dissemination of SFP stories amongst the general public, allowing the readers to visualize themselves as potential users. This would allow them to provide relevant feedback on the salient aspects of the technological prototype, thereby helping developers to fine-tune the technological prototype. Such dissemination will also create greater social awareness about emergent technologies which, in turn, can lead to a simultaneous exploration of services that can emerge in the future. Thus, SFP stories are an evolution of Design Fiction, the direct outcome of Design Thinking. In the Indian context, product designers and manufacturers have no access to Design Fiction, let alone Science-Fiction Prototyping; hence, they continue to use the incremental method of product innovation and design. While academic courses launched by premier technical institutions are an attempt to address this shortcoming, greater gains can be accrued when Science-fiction Prototyping is deployed inside classrooms in higher education institutions. In fact, Science-fiction Prototyping can enable India's young adult learners to take early cognitive leaps and engage in the analysis and design of products and services that will become relevant in the future.

Science-fiction Prototyping and Its Place Inside NEP 2020's Flipped Classroom
The usefulness of SFP in classroom teaching has already been seen in teaching English as a foreign language, STEM courses, and security education (Zhang and Callaghan, 2014; De Lepe et al., 2015; Kohno and Johnson, 2011). The Indian education system has thrown a timely opportunity to deploy SFP as a valuable tool in the teaching-learning process aimed at nurturing a work-force that is prepared for the future. The recently-launched New Education Policy 2020 has made an attempt to revamp the traditional method of rote-learning through a radical pedagogical approach that aims at imparting multi-disciplinary, inter-disciplinary, context-based education—the flipped classroom setup. It is aimed at facilitating acquisition of problem-solving and critical thinking skills (Gupta, 2020). Students aren't 'taught' in a top-down manner as seen in present class-room teaching. Instead, a flipped classroom pursues inquiry-based and discussion-based method of learning through which gaps in the student's knowledge are identified and addressed. This is crucial since it is well-acknowledged that while Indian students score well in exams, they are unable to deploy academic knowledge in solving real-life problems (Chaudhary, 2013; Dhillon, 2015; Rahman, 2015; Mahapatra, 2017; Chakraborty, 2019; Das, 2019; Samtani, 2019).

Further, it is quite evident that classroom discussion isn't an adequate tool to instil critical thinking and problem-solving since participation of all students and goal-oriented discussion cannot be always guaranteed. Also, while inquiry and discussion can initiate the learning process, they are not the ideal tools to concretize critical thinking and problem-solving as a cognitive skill. This is where writing-based exercises centred around SFP narratives can step in. The impact of (both self-regulated or mediated) writing on cognitive development has already been well-researched and acknowledged (Lunsford, 1979; Schultz, 1991; Olson, 2002; Kellogg, 2008; Bazerman, 2009; Zhang, 2021). For concretizing critical thinking and problem-solving, SFP writing resorts to the development and dissemination of contexts inside the classroom. This is crucial in the Indian context since Indian students, especially those studying in higher education institutions, aren't given adequate exposure to the context of their learning. SFP writing would be a more than adequate tool to address this need since it begins with drawing the writer's attention to the context of the SFP story worlds. Like Science-fiction, SFP narratives are set in an alternate (future) world that hasn't materialized yet. Since this future isn't 'pre-given' SFP writers can explore the manner in which the material and human components in a future context will turn out to be different from contemporary reality. SFP writing, in fact, reins in the limitless freedom given to human imagination in science-fiction by contextualizing the narrative's technological prototype within a (ironically) socio-historical context dominated by a technological prototype in order to evaluate its "inflection points" (Johnson, 2010).

SFP story worlds, thus, are constructed not on the basis of the static 'what is', but rather the dynamic 'what if'. Every attempt at SFP writing begins with developing the context of these narratives, the

possibilities of change available in such contexts, the technological solutions that can be deployed in such moments of change, and the problems that become apparent when the human characters respond to such changes. Further, students would have to go beyond the boundaries of their respective disciplines in order to assess which components of these futuristic physical spaces and populated by human characters embodying a variety of motivations and/or attitudes are prone to change. Imagining changeable contexts would, thus, require students to adopt a multi-disciplinary/inter-disciplinary approach, thereby broadening their epistemic horizons as envisaged in NEP 2020 (Aithal et al., 2020). By using such an approach, students would be able to identify and focus on multiple elements that affect humans as they go about living their daily lives, thereby inculcating the ability to empathize with them. Subsequently, students would be able to create newer contexts by manipulating the pre-existing contexts in science-fiction literature, identify gaps and/or opportunities in these contexts, and devising solutions that can address these gaps and/or opportunities. Thus, the world-building exercise that is central to SFP writing will give students the chance to develop and hone their design abilities, beginning with the users inside that context, the problems that afflict them, and the demands and expectations from proposed technological solutions to that the problem. The extrapolation of contemporary tendencies into the future, and creating scenarios based upon them in their SFP narratives would help students in expanding their epistemic horizons. SFP writing, in fact, blurs the boundaries between traditional design practices (that are capital and time-intensive) and narrative exploration of future possibilities. However, in no way it is being suggested that SFP writing can replace traditional design practices. Traditional designers can, it is believed, find SFP stories as a source of inspiration for developing newer ideas, identifying newer consumer needs, demand for original products, and emergent consumer behaviour (Nikolova, 2021). When deployed as an educational strategy, SFP-writing encourages students to give up rote-learning and deploy conceptual knowledge to imagine and ideate about things that don't exist yet, but whose materialization in the future can solve the (emergent) problem. This is particularly important in a country like India where cognitive bias towards already-existing problem-solving methods (including Indians' love for 'jugaad') gets cemented in higher-degree programs of a student's academic life. SFP-writing shakes up the rote method of learning by asking the student 'designers' to reason out the suitability/impact of the various elements of the solution-design process. This fixation is further broken when SFP-writing is attempted as a collaborative process between students belonging to different disciplines.

CONCLUSION:
With the call for 'Make in India', the intent of the Indian government to transform Indian economy and society has been signalled. Economic, infrastructural and bureaucratic frameworks have already been put in place to facilitate setting up of manufacturing facilities in India. India has also witnessed the launch of NEP 2020, touted as 21st century education whose greater emphasis on STEM courses will drive the nation's economic and national competitiveness, and will produce the new-age workforce. However, it is also becoming apparent that focus on STEM alone cannot be the basis of solving present and future problems. Human users are as much important as the technological prototypes being developed to improve their everyday experience. The neglect of Arts, thus, needs to be addressed by including it into STEM (indicated in the moniker STEAM). However, Arts disciplines too need to evolve in order to prove their relevance in preparing students for the changing world and workforce. Science-fiction Prototyping becomes that valuable academic tool drawing from the disciplines of STEM as well as Arts, that reorients teaching/learning from purely academic goals to the design of implementable solutions, which focuses not only on the end-product but also the process. The launch of Design Thinking courses by prestigious institutions such as IITs and Delhi University have made an attempt to address the demand to upskill the present workforce, their course content lacks a sound academic tool that can be deployed inside class-rooms across higher educational institutions in India. Science Fiction Prototyping comes across as that tool which can address the complex set of demands of a society such as India's, especially since it is a cost-effective tool that can be easily integrated into the flipped classroom setup envisioned in NEP 2020. Exposure to science fiction literature and films comes early these days as the genre has found acceptance amongst the mainstream audience. A list of recommended readings can be easily drawn up for students of all ages, and all social groups. From these, a variety of visions of the future can be extracted (Reynolds, 1977; Fergnani, Song, 2020) in order to help students identify a wide assortment of 'contexts' which they can learn to manipulate in order to 'contextualize' the academic topics in their curriculum. Most importantly, prototyping will push them to come out of their contemplative attitudes and work upon

technological prototypes and/or services that can become relevant in such futures, thereby setting them on the path of becoming the new-age problem-solvers that India needs.

REFERENCES

1. Aithal, P. S., and Shubhrajyotsna Aithal. "Analysis of the Indian National Education Policy
2. 2020 towards achieving its objectives." International Journal of Management,
3. Technology, and Social Sciences (IJMTS) 5.2 (2020): 19-41.
4. Aithal, P. S., and Shubhrajyotsna Aithal. "Implementation strategies of higher education part
5. of national education policy 2020 of India towards achieving its objectives."
6. International Journal of Management, Technology, and Social Sciences (IJMTS) 5.2
7. (2020): 283-325.
8. Bina, O., Mateus, S., Pereira, L., & Caffa, A. (2017). The future imagined: Exploring fiction
   a. as a means of reflecting on today's Grand Societal Challenges and tomorrow's
   b. options. Futures, 86, 166-184.
9. Bahrin, M. A. K., Othman, M. F., Azli, N. H. N., & Talib, M. F. (2016). Industry 4.0: A
10. review on industrial automation and robotic. Jurnal teknologi, 78(6-13).
11. Bazerman, C. (2009). Genre and cognitive development: Beyond writing to learn. Pratiques.
12. Linguistique, littérature, didactique, (143-144), 127-138.
13. Brander, J. A., Cui, V., & Vertinsky, I. (2017). China and intellectual property rights: A
14. challenge to the rule of law. Journal of International Business Studies, 48, 908-921.
15. Brenner, W., & Uebernickel, F. (2016). Design thinking for innovation. Research and practice.
16. Brown, T. (2008). Design thinking. Harvard business review, 86(6), 84.
17. Chakraborty, R. (2019). Only 7 per cent engineering graduates employable: What's wrong
    a. with India's engineers? https://www.indiatoday.in/education-
    b. today/featurephilia/story/engineering-employment-problems-329022-2016-07-13.
18. Chaudhary, L. (2013). Unskilled, unemployed, angry: Is India Tomorrow headed for disaster?
    a. https://www.firstpost.com/india/unskilled-unemployed-angry-is-india-tomorrow-
    b. headed-for-disaster-706054.html.
19. Chaudhary, M., Sodani, P. R., & Das, S. (2020). Effect of COVID-19 on economy in India:
20. Some reflections for policy and programme. Journal of Health Management, 22(2),
21. 169-180.
22. Chenoy, D., Ghosh, S. M., & Shukla, S. K. (2019). Skill development for accelerating the
23. manufacturing sector: the role of 'new-age' skills for 'Make in India'. International
24. Journal of Training Research, 17(sup1), 112-130.
25. Cross, Nigel. "Designerly ways of knowing." Design studies 3.4 (1982): 221-227.
26. Csicsery-Ronay, I. (2012). The seven beauties of science fiction. Wesleyan University Press.
27. Das, P. (2019). 54 per cent youth are not job-ready: AICTE, UN development prog led
    a. survey finds https://www.edexlive.com/news/2019/dec/10/54-per-cent-youth-are-not-
    b. job-ready-aicte-un-development-prog-led-survery-finds-9482.html.
28. Dam, R. F. (2024, March 1). The 5 Stages in the Design Thinking Process. Interaction Design
    a. Foundation - IxDF. https://www.interaction-design.org/literature/article/5-stages-in-
    b. the-design-thinking-process, Accessed 17-09-2024, 5:50 P.M.
29. De Lepe, M., Olmstead, W., Russell, C., Cazarez, L., & Austin, L. (2015, July). Using
30. Science Fiction Prototyping to Decrease the Decline of Interest in STEM Topics at the
31. High School Level. In Intelligent Environments (Workshops) (pp. 189-196).
32. Fergnani, A., & Song, Z. (2020). The six scenario archetypes framework: A systematic investigation of science fiction films set in the future. Futures, 124, 102645.
33. Gupta, Raghav. "NEP 2020: How Teachers Can Shape Students for a 'New India.'" India Today, India Today, 4 Sept. 2020, www.indiatoday.in/education-today/featurephilia/story/nep-2020-how-teachers-can-shape-students-for-a-new-india-1718671-2020-09-04.
34. Dhillon, A. (2015). India's jobs shortage: PhDs, graduates among millions applying for
    a. menial jobs https://www.smh.com.au/world/indias-jobs-shortage-phds-graduates-
    b. among-23m-applicants-for-office-boy-positions-20150925-gjuktu.html.
35. Hajduk, M., & Koukolová, L. (2015). Trends in industrial and service robot application. Applied Mechanics and Materials, 791, 161-165.
36. IFR International Federation of Robotics. (n.d.). Global Robotics race: Korea, Singapore and Germany in the lead. https://ifr.org/ifr-press-releases/news/global-robotics-race-korea-singapore-and-germany-in-the-lead, DoA 17-09-2024, 5:24 pm
37. Jha, Anand Mohan, Amrit Kumar Jha, and Sanjeev Kumar Jha. "National Education Policy 2020: A step towards technology driven education and self-reliant India." Solid State Technology 63.6 (2020): 9475-9482.
38. Johnson, B. D. (2011). Science fiction prototyping: Designing the future with science fiction. Morgan & Claypool Publishers.
39. India@100: Reaping the Demographic Dividend. (2023, April 11). EY. https://www.ey.com/en_in/insights/india-at-100/reaping-the-demographic-dividend
40. Kamath, S. S. (2024). Science Fiction Prototyping in English as a Design Thinking Tool to Inspire the Future. ENGLISH ACROSS DISCIPLINES, 160.
41. Karabegović, I. (2018). THE ROLE OF INDUSTRIAL AND SERVICE ROBOTS IN THE 4th INDUSTRIAL REVOLUTION-" INDUSTRY 4.0". Acta Technica Corviniensis-Bulletin of Engineering, 11(2), 11-16.
42. Kellogg, R. T. (2008). Training writing skills: A cognitive developmental perspective. Journal of writing research, 1(1), 1-26.

43. Kiyokawa, Sachiko, et al. "Science fiction prototyping method improves readers' narrative experiences." IIAI Letters on Informatics and Interdisciplinary Research 3 (2023).

44. Kohno, T., & Johnson, B. D. (2011, March). Science fiction prototyping and security education: Cultivating contextual and societal thinking in computer security education and beyond. In Proceedings of the 42nd ACM technical symposium on Computer science education (pp. 9-14).

45. Kotecha, M. C., Chen, T. J., McAdams, D. A., & Krishnamurthy, V. (2021). Design ideation through speculative fiction: Foundational principles and exploratory study. Journal of Mechanical Design, 143(8), 080801.

46. Kratz, A., & Boullenois, C. (2023). Irrational expectations: long-term challenges of diversification away from China. Rhodium Group, 13.

47. Kumar, Kishore, Ajai Prakash, and Krishanveer Singh. "How National Education Policy 2020 can be a lodestar to transform future generation in India." Journal of Public affairs 21.3 (2021): e2500.

48. Kurien, Ajay, and Sudeep Chandramana. "Impact of new education policy 2020 on higher education." Atma Nirbhar Bharat: A Roadmap to Self-reliant India (2020).

49. Kymäläinen, T. (2016). Science fiction prototypes as a method for discussing socio-technical issues within emerging technology research and foresight. Athens Journal of Technology & Engineering, 3(4), 333-347.

50. Liedtka, J. (2015). Perspective: Linking design thinking with innovation outcomes through cognitive bias reduction. Journal of product innovation management, 32(6), 925-938.

51. Lombardo, T. (2006). Contemporary Futurist Thought: Science Fiction. Future Studies, and
a. Theories and Visions of the Future in the Last Century. AuthorHouse.

52. ———— (2015). Science fiction: The evolutionary mythology of the future. Journal of
a. Futures Studies, 20(2), 5-24.

53. Lunsford, A. A. (1979). Cognitive development and the basic writer. College English, 41(1), 38-46.

54. Mahapatra, R. (2017). Time to wage a war on rote learning, but it will need courage and
a. perseverance https://www.hindustantimes.com/columns/time-to-wage-a-war-on-rote-
b. learning-but-it-will-need-courage-and-perseverance/story-
c. WGRXtKiH3uCmbro3gC3kIO.html.

55. Mehta, Y., & Rajan, A. J. (2017). Manufacturing sectors in India: Outlook and challenges. Procedia engineering, 174, 90-104.

56. Michaud, Thomas, and Francesco Paolo Appio. "Envisioning innovation opportunities through science fiction." Journal of product innovation management 39.2 (2022): 121-131.

57. Muehlfeld, K., & Wang, M. (2022). Intellectual Property Rights in China—A Literature Review on the Public's Perspective. Frontiers in Sociology, 7, 793165.

58. Nicholes, Justin. "Science fiction prototyping's features and impact on college students' perceptions of writing: An applied literariness study." Scientific Study of Literature 10.1 (2020): 98-134.

59. Mann, Samuel, et al. "Educational design fictions: Imagining learning futures." Industry practices, processes and techniques adopted in education: Supporting innovative teaching and learning practice. Singapore: Springer Nature Singapore, 2022. 303-326.

60. Nakata, C., & Hwang, J. (2020). Design thinking for innovation: Composition, consequence, and contingency. Journal of business research, 118, 117-128.

61. Nicholes, J. (2018). Developing STEM interest and genre knowledge through science fiction prototyping. The STEAM Journal, 3(2), 14.

62. Olson, D. R. (2002). What writing does to the mind. In Language, literacy, and cognitive development (pp. 171-184). Psychology Press.

63. Pathak, S. (2018). From Strategic Trade to Weaponization of Trade. IndraStra Global, 4(5), 1-4.

64. Pathak, Rakesh, and R. Pathak. "National Education Policy 2020: can it improve faculty motivation and academic outcomes in India." International Research Journal of Modernization in Engineering Technology and Science 3.4 (2021): 573-579.

65. Pradhan, H. K., & Agarwal, P. K. (2020). MSME Financing in India: Key to the 5 Trillion Economy. Inclusive Finance India Report, 137.

66. Rahman, S. (2015). 2.3 Million Apply for 368 Office Jobs in Indian State Government
a. https://www.voanews.com/a/indian-state-government-swamped-with-applications-
b. for-peon-job/2968912.html.

67. Reynolds Jr, J. C. (1977). Science Fiction in the 7–12 Curriculum. The Clearing House,
68. 51(3), 122-125.

69. Roberts, A. (2002). Science fiction. Routledge.

70. Potstada, M., & Zybura, J. (2014). The role of context in science fiction prototyping: The digital industrial revolution. Technological Forecasting and Social Change, 84, 101-114.

71. Samtani, N. (2019). How to address India's unemployability problem?
a. https://timesofindia.indiatimes.com/blogs/the-growth-catalyst/how-to-address-indias-
b. unemployability-problem.

72. SAMARTH Udyog. (n.d.). https://www.samarthudyog-i40.in/

73. Sahoo, M., Mallick, H., Kumar Mahalik, M., & Bekiros, S. (2022). Factors influencing India's current account balance: Implication for achieving its external sector sustainability. Journal of Public Affairs, 22(1), e2311.

74. Schultz, J. M. (1991). Mapping and cognitive development in the teaching of foreign language writing. The French Review, 64(6), 978-988.

75. Suvin, D. (1972). On the poetics of the science fiction genre. College English, 34(3), 372-382.

76. Tschimmel, K. (2012). Design Thinking as an effective Toolkit for Innovation. In ISPIM Conference Proceedings (p. 1). The International Society for Professional Innovation Management (ISPIM).

77. Woodhouse, E., & Patton, J. W. (2004). Introduction: design by society: science and
78. technology studies and the social shaping of design. Design issues, 1-12.
79. Zhang, S., & Callaghan, V. (2014, June). Using science-fiction prototyping as a means to motivate learning of STEM topics and foreign languages. In 2014 international conference on intelligent environments (pp. 353-356). IEEE.
80. Zhang, B. (2021). Engaging in dialogue during collaborative writing: The role of affective, cognitive, and social engagement. Language Teaching Research, 13621688211054047.