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Robots for Revitalization

The Japanese Sociotechnical Imaginary about Service Robots

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要旨

本論文では、日本におけるサービスロボットの開発と普及を研究する。サービスロボットとは、産業用ロボットと違って工場で動作するのではなく、家庭や街など、普段人間が日常生活を行うような環境で動作するロボットとのことである。

日本は世界一の産業用ロボットの生産国であり、ロボット王国、あるいはロボット大国とも言われている。その上、1990 年代以来、高度の技術を使用する人間型や動物型などのサービスロボットが日本で開発されていることも世界中で注目を集めている。

日本におけるこうした特徴的なロボットの普及の理由を解くため、先行研究では、様々な理論が挙げられているが、それらは二種類に大別できる。一方では、アニミズムによる人工物へのポジティブな姿勢、漫画とアニメにおけるロボットのポジティブな表現、からくり人形という伝統的な技術との親和性など、「ロボット好きな日本人」の原因として、日本文化の独自的な要素を挙げる考え方がある。他方では、「ロボット好きな日本人」という概念を、エンジニア、ロボットメーカー企業や公的機関など、有力な社会的なアクターによって構築されたアイディアだとする考え方もある。

本論文においては、後者の立場から、社会技術的想像力（Sociotechnical imaginary）という理論フレームワークに基づいて、特にサービスロボットの開発と普及における政府の役割を分析している。社会的技術想像力というのは、集合的に共有されている、制度化した、望ましい未来の社会のビジョンとのことである。このビジョンは技術によって実現できるだとされていると同時に、その技術を方向づけ、その開発と普及を支援する。本研究では、1990 年代から現在までの時期を中心に、ロボッ

トに関する方針の分析し、サービスロボットに関する社会技術的想像力の創発を明らかにする。それを、「Robot for Revitalization」（再生のためのロボット）と名付ける。

長期不況と少子高齢を背景に、科学技術創造立国という概念の下で、1995 年に科学技術基本法が施行され、科学技術が経済成長のための資源、そして社会問題への対応として見なされるようになった。サービスロボットも例外ではない。産業用ロボットは元々、工場において、効率化、生産力、安全性を高める機械であった。ロボットに関する方針において、サービスロボットも、日常生活に普及するとともに、少子高齢化による人手不足に対応し、サービス業界の低い生産力を高め、ユビキタスセンサーのネットワークによって安全・安心のある社会を作る、という期待がある。また、サービスロボットが家事、子育て、高齢者の介護の負担を減らし、人々の生活において、便利・ゆとりを創発することによって、高齢者や女性の社会参加率が高まると考えられている。つまり、人間とロボットが共存する社会で、経済復興と社会の活性化を同時に果たすというのは、「Robots for Revitalization」という未来のビジョンなのである。

さらに、政府がこのようなビジョンを EXPO やオリンピックなどのイベントによってどのように公的に演じ、宣伝材料においてどのように描いていることも分析する。伝統文化とポップカルチャーのアイコンと親しみやすいナレーションによって、ロボットを自然的な存在として描かれているというパターンが明らかにする。

ところが、社会技術的想像力は完全に社会から受け入られるわけではない。サービスロボットが社会に普及しながら、色々な社会的なアクターがその技術に抵抗したり、あるいは折衝することで、社会技術的想像力を変化させる可能性がある。本研究では、特に介護ロボットの使用される場面を、その抵抗と折衝を起こす場面だ

と推測する。それは、介護は人間関係が重要な活動であり、日本においては伝統的に家族によって行われているからである。介護機関で行われた研究においては、「人の手による暖かい介護」と「機械による冷たい介護」との紛争が明確にされた。本研究では、介護ロボットを主人公としている「老人 Z」というアニメの分析によって、同じ結論に達する。

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Introduction

Japan enjoys a reputation of being a highly technological countries and a robot paradise. Indeed, the country is a leading manufacturer of industrial robots and has a high degree of automation in the industrial sector. In the last decades, however, Japanese robotics has engaged more and more with the research and development of service robots, or robots that interacts with humans outside of the factory, in private houses and public spaces.

There have been many attempts to explain the rapid development of the robot industry in Japan. Mainstream discourse usually proposes cultural explanation, stating that Japanese people are more apt to accept robots than other nationalities because of some peculiar cultural values. This discourse is articulated and recurs to different cultural aspects to justify its proposition: religious beliefs and animism, a positive representation in popular media like science fiction and anime/manga, or genealogical linkages with indigenous artifacts, like the Edo-Period mechanic dolls, are just some examples.

However, this discourse has been repeatedly criticized for its essentialist nature, for resorting to unproven stereotypes, and for fostering nationalistic ideology. Other critiques have pointed out that, while cultural factors might be in play, they should not be understood as completely endogenous. According to this approach, cultural factors are better understood as being constructed, or in a relationship of reciprocal construction with robotic technologies.

Indeed, a closer look at the Japanese discourse on robots reveals that government, makers and other actors play a major role in its development, which is influenced by their expectations and pragmatical concerns. Firms and makers see the development of service robots as a possibility for the opening of a new promising market. The government is interested in service robots as a possible solution to two of its major concerns, economic stagnation of the country and super-aging society. The discourse that promotes Japan as a country ready to accept robots, then, is constructed to familiarize the public with them and facilitate their diffusion.

Care robots in particular are a major interest for institutions, which see in them an optimal solution for the many problems caused by the super-aging society, including the increased burden that the rapidly growing old age group poses on families, caregivers and on the National Health Service, the shrinking of the workforce and the consequent shortage of caregivers, and the diminishing quality of life of non-autonomous older people and their families.

However, while it may be true that many Japanese people have a high degree of familiarity with robots, that does not mean that they are prone to an acritical acceptance of their introduction in society. This is particularly true for care robots, which are developed for the assistance of elderly people or patients. As care is an activity traditional entrusted to families and involving a high degree of human interaction, the introduction of robots is prone to raise ethical questions and to be criticized, as it has indeed happened in many cases in Japan. Care robots, then, represent a perfect case study to show the ongoing negotiation between social actors in the Japanese discourse on robots.

I contribute to the field with the idea that service robots can be analyzed in the theoretical framework of sociotechnical imaginaries, which has been proposed in the field of Science, Technologies and Societies (STS) by Jasanoff & Kim, in order to better understand how the state shapes the development of science and technologies by proposing a vision of how the future ought to be. This can be done by analyzing the development of state policies about robots and their intertwinement with basic S&T policies and economic policies. In doing this, the aim of this work is to discover how the Japanese states conceives the role that service robots will have in the future and how it mediates between other actors to ensure that the robot technology is developed in the intended way. I propose to describe this vision as "Robots for Revitalization".

My master thesis will consist of three main sections. The first will introduce the context of robots in Japan and discuss the discourse about them. Through the analysis of previous literature on the topic, I will show how the cultural factors have been questioned and that the discourse is constructed by powerful actor with their own motivations. I then propose the framework of sociotechnical imaginaries to analyze the discourse on robots.

The second section develops on the sociotechnical imaginaries framework to analyze policies and media produced by institutions to promote the development of the service robot industry. First, I provide a sociohistorical background, describing the economic crisis and social problems that arose in Japan during the '90s, and how governments started to conceive their S&T policies as a solution to those problems. I then retrace policies concerning robots starting at the turn of the millennia, analyzing how the imaginary about service robots evolved over the course of the year and became a constituent part of the Abe administration economic policies, finally flowing into the wider imagination of Society 5.0 proposed 2017. In the last section, I analyze how the imaginary is actively staged and performed by institutions, through megaevents such as EXPO and the Olympics, public demonstrations, and science fictional

promotional material, that communicates the institutions' vision to the public and normalize the use of robots in everyday life.

The last section is focused on care robots. First, I show how care robots are a particularly interesting object of study to question the constructedness of the Japanese discourse on robots, by presenting previous literature that has investigated controversies and debates about them. I then provide a case study of my own, analyzing *Roujin Z*, a 1991 science fiction anime centered around an imagined care robot. Through the movie analysis, I uncover the existence of an imaginary which contrasts warm human care to cold robot care, conflicting with the "Robots for Revitalization" imaginary proposed by institutions.

Chapter 1

In the present chapter, I will describe the context of robots in Japan and discuss the discourse on robots that is prevalent in the country. The first section will provide definitions of various types of robots that I will discuss about in this thesis. The second one gives a brief description of robots in the Japanese contexts, showing how the country is one of the most roboticized in the world. The third one gives an account of the various cultural factors that are often called upon to explain the prevalence of robots in Japan; it introduces the concepts of a "Japanese love of robots" and discuss it critically, analyzing previous literature. The fourth section introduces the main research question: how does the Japanese sociocultural context influence the diffusion of robots in the country, and what does robots and the discourse about them tell us about that context? It further provides the theoretical framework and the methodology used.

1.1 What is a robot?

To describe what a robot is, let us start with the etymology of the word. Notoriously, the word *robot* comes from the Czech *robota*, meaning forced labor, and was first popularized by Karel Čapek (his brother was the one to invent it) in the 1922 science fiction (SF) play "*R.U.R.*", which stands for Rossum's Universal Robots, in which he envisioned a factory producing synthetic humans to replace human labor. The popularity of the play soon led to the word being spread throughout the world. In the West, it eventually became a synonym of, and partially replaced, the word *automaton*, coming from ancient Greek, and its derivatives. Automaton means "self-moving", and it is used to describe a self-moving machine, a meaning that broadly corresponds to that of robot. In modern usage, though, robot usually describes an electronic machine – although Čapek's robots where organic, more akin to replicants – while automaton refers mostly to pre-industrialization-era, mechanical devices.

But what is exactly a robot? It is easy to imagine one: most of us will picture familiar images of robots seen in countless SF movies or cartoons, often humanoid in appearance, usually endowed with intelligence that might be distant, alien and threatening, but also friendly and maybe expressing human-like emotions; those more inclined to realism will imagine a robotic arm on the assembly line of a factory, or perhaps a home-cleaning robot, or a rover on Mars. However, it is harder to trace the line between what a robot is and what a robot isn't: nowadays, many machines that one wouldn't normally consider a robot have such a degree of automation that they blur that line. I believe there are three defining factors that can be considered to distinguish robots from other types of automatic machines:

- Being a machine equipped with more than just mechanical technology (typically, at least informatics and electronics, often much more), which differentiates it from the older mechanical automata.
- Having the ability to perform a complex series of actions automatically, either through direct human control or through being programmed, which differentiates it from simpler automatic machines like a washing-machine.
- Having the ability to move and/or interact with the physical environment, which differentiates it from purely cybernetical machines which lack a physical body, like chatbots and the likes[1].

My definition of robot is largely superimposable with the one provided by Robertson in her works on robots and Japan:

> A robot is an aggregation of different technologies […] that make it capable of interacting with its environment, with some human supervision (through teleoperation) or autonomously[2].

These are, obviously, very vague definitions, and that is intended, because definitions of robot can differ greatly depending on the context in which they are used or with time: for example, trying to define what technologies makes a robot is a difficult task, because those technologies get upgraded constantly. Note that many institutional sources in Japan, such as the New Energy and Industrial Technology Development Organization (NEDO), admit to utilize even broader definitions, considering a robot or robotic technology everything that can produce added value through automation processes – a definition conveniently based on projected expectations rather than intrinsic characteristics[3].

One factor that should not be considered as a defining feature, in my opinion, is the function of the robot. Many definitions suggest that a robot's function is to replace human effort or to assists humans in performing tasks more efficiently; for example, the Encyclopedia Britannica defines a robot as "any automatically operated machine that replaces human effort, though it may not

[1] Although I must note that, during my research for this work, I encountered some machines being referred as robots that cannot move nor interact with the environment, at least in a strict sense.
[2] Jennifer Robertson, *Robot sapiens japanicus: robots, gender, family and the Japanese nation* (Oakland: University of California Press, 2018), 5.
[3] NEDO (New Energy and Industrial Technology Development Organization), *NEDO robotto hakusho 2014 NEDO ロボット白書 2014* [NEDO White paper on robots 2014], accessed December 14, 2022, https://www.nedo.go.jp/content/100567345.pdf, p. 1-3.

resemble human beings in appearance or perform functions in a humanlike manner"[4]. Surely, this is faithful to the original meaning of the word conceived by the Čapek brothers – as mentioned previously, the word derives from the Czech for "forced labor". However, nowadays, there are many robots that do not respond to this definition. Think of a robot-toy: what effort does it replace? Sure, from the perspective of a busy parent, it could replace the effort of playing with the child; but the adult might decide to play with the child and the robots together, a situation in which the robots does not replace any effort, it rather provides entertainment value and enhances the experience of playing.

The function, thus, is not a defining factor for what a robot is. However, it is useful for classifying robots. In this work, I propose a classification in three macro-categories based on the environment in which robots work. Inside the macro-categories it is possible to further categorize robots according to their function. The classification proposed here is not universally accepted and not perfect, but it will suffice for the purpose of my analysis.

- Industrial robots: these were the first robots to be developed on a large scale. They are used in factories to replace human labor, and their rapid development and diffusion in the second half of last century can be explained by the favorable environment in which they operate. A factory line can be designed to accommodate the industrial robot, while other environments have a much higher degree of unpredictability, which arguably slowed the development of other types of robots.
- Service robots: these robots work alongside humans in non-industrial environments, like houses, hospitals, parks, shops and so on. Their degree of interactions with humans is often much higher than in industrial settings. In this work I mostly discuss this category of robots.
- Robots for hostile environments: this includes robots that works in environments which are dangerous or unlivable for humans, such as space, underwater, and so on.

Among industrial robots, we find painting robots, welding robots and many others. Robots for hostile environments would include space exploration robots, underground robots, and military robots. Service robots include chore robots (cleaning robots, cooking robots, etc.…), transportation robots, agricultural robots, medical robots, entertainment robots, social robots, care robots, and more. Given that the focus of this thesis is on social and care robots, I will

[4] Peter H. Moravec, "robot", *Encyclopedia Britannica*, accessed December 14, 2022. https://www.britannica.com/technology/robot-technology.

discuss in more details these two types and that of socially assistive robots, that is at the intersection of the two.

- Social robots: I have a very broad understanding of this category. I use social robots to describe all types of robots whose main purpose is to interact with humans through communication. This means that I include commercial robots used in hospitality and retail, as well as robotic pets, personal assistants and so on. Oftentimes they are equipped with humanlike or animal-like appearance, which is more familiar to users and facilitate the interaction with the robot, and they may be equipped with artificial intelligence and language recognition in order to simulate natural responses.
- Care robots: their main purpose is to assist in the daily care of elderly people, the disabled or people in need of special assistance. They may be used in private households as well as institutions and may partially overlap with medical robots, which are used mostly in hospitals to perform specialized medical tasks. They include a wide range of robots with different purposes, from robotic lifters to exoskeletons.
- Socially assistive robots: at the intersection of social robots and care robots we find socially assistive robots, which are social robots used for care purpose. In this case, the social function of interacting with humans is used for its benefit on mental health, targeting various condition that range from autistic disorder in children to Alzheimer's disease and dementia in older adults.

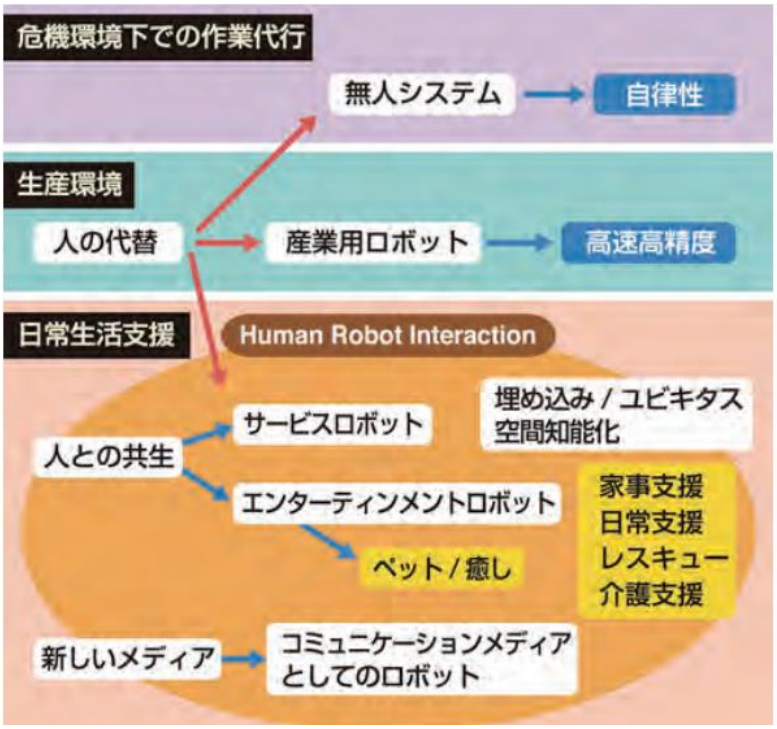

Figure 1: Classification of robots based on environment and function.
Source: NEDO

Needless to say, the categorization and definitions here proposed are far from being exhaustive, and there are many categories that may partially overlap, but they will be useful enough to start talking about robots. Moreover, they correspond neatly to classification systems used in Japanese institutional literature, like the NEDO white paper on robots[5].

1.2 Robots in Japan

After having clarified what is the object of study in this work, I will establish the context in which I will analyze it: Japan. Japan has a long history and deep engagement with robotics: industrial robots, the first kind of robots fitting our definition to be developed, came to Japan in 1967, only a few years after their invention and diffusion in the US, and soon Japanese companies started to produce them domestically[6]. In the next decade, Japanese research institutes started developing their own technologies, and between the '70s and the '80s, the country came to be seen as one of the leaders in robotic innovation. In 1986, 116,000 industrial robots were operating in Japan, around 60% of the total in the Western Bloc. The country had become the one with the highest robot density (number of units operating per 10,000 employees), surpassing Sweden[7].

What about the present? According to the International Federation of Robotics (IFR) statistics for 2022, notwithstanding more than twenty years of economic stagnation, Japan is the predominant manufacturing country for industrial robots with more than 186,000 units exported. It is the second largest market for industrial robots with more than 47,000 units installed, and has the second largest operational stock (number of units currently operating) with almost 400,000 units; China, which surged to the first place in terms of operational stock in the last few years after an ambitious plan of investments in industrial robotics, imports much of its robots from Japan[8]. In terms of robot density, today Japan is third after South Korea and Singapore. Undoubtedly, the country is still one of the most roboticized in the world.

Things are different when we look at service robots. Japan is considered a pioneer for its researches on humanoid robots: WABOT, the first intelligent humanoid robot, was developed

[5] NEDO, *NEDO robotto hakusho 2014*, 1-6.
[6] "History of Kawasaki Robotics", Kawasaki Robotics, accessed December 14, 2022, https://kawasakirobotics.com/company/history/.
[7] Frederik L. Schodt, *Inside the Robot Kingdom: Japan, Mechatronics, and the coming Robotopia*, (San Francisco: JAI2, 2011), Kindle.
[8] IFR (International Federation of Robotics), *World Robotics Report: "All-Time High" with Half a Million Robots Installed in one Year*, accessed January 13, 2023, https://ifr.org/downloads/press2018/EN-WORLD-2022-OCTOBER-13_IFR_press_release_World_Robotics_2022.pdf.

at Waseda University in 1973[9], followed by many other humanoid robots that spawned stunning technological breakthroughs. Moreover, Japanese companies have developed some of the most famous social robots in the last three decades: Honda's humanoid robot ASIMO[10], publicized as "the world's most advanced robot", or the therapeutic robot-seal PARO[11], certified by the Guinnes World Records as "world's most therapeutic robot", are just a few examples. However, Japan is not the biggest market nor the biggest maker. In fact, many of its social robots struggled to achieve commercial success or did not debut commercially at all, being primarily developed for research purposes. In any case, while their impact on markets might pale in front of less spectacular robots like the robot vacuums of the US-based iRobots[12], their technological achievements are unquestionable, as the hype that surrounds many of them.

The importance of this mediatic successes should not be underestimated: from spectacularized robot combats like the TV show "Robot Wars", to official competitions like the one hosted by the US Defense Advanced Research Projects Agency (DARPA), an agonistic attitude runs deep in the world of robotic. In Japan, one could say that it is felt on a national scale, where the competition is fought through the aforementioned statistical indicators. Two expressions of common use in public discourse in the country employ geopolitical metaphors to express this competitive mindset: *robotto ōkoku* (ロボット王国, "the Robot Kingdom") and *robotto taikoku* (ロボット大国, "great power of robotics"). They are called upon at times to assert the country's predominance in the field, at times to raise the alarm about losing it.

Regardless of its concrete achievements in robotics, for how much genuine they may be, today Japan's most evident success as "great power of robotics" may be in terms of imaginary. Singapore and South Korea may have a higher degree of automation, China a higher total number of robots and US the most innovative companies, but no other country is so closely associated to robots in the collective imaginary as Japan is. This is visible both internally, in the extreme popularity that robots have in the country, and externally in the image that people in other countries held of Japan.

[9] "History of Humanoid Robot in Waseda University", Humanoid Robotics Institute Waseda University, accessed December 15, 2022, https://www.humanoid.waseda.ac.jp/history.html.
[10] "ASIMO by Honda | The World's Most Advanced Humanoid Robot", Honda, accessed December 15, 2022, https://asimo.honda.com/.
[11] "PARO Therapeutic Robot", PARO Robots, accessed December 15, 2022, http://www.parorobots.com/.
[12] "History", iRobot, accessed December 15, 2022, https://about.irobot.com/en-us/history.

Domestically, as Frederik L. Schodt argued in his seminal book on the topic:

> Robots are popular in other nations too, but only Japan has so successfully linked ancient automata, comic book and animation characters, toys, industrial robots, and research robots into one giant romanticized entity in the public mind[13].

Indeed, both fictional and real robots are celebrated in Japan, and the Japanese seem to have a special relationship with them. Many long-lasting media franchises starring robots as characters are among the highest grossing of all times: Doraemon, Gundam and Neon Genesis Evangelion are just a few examples. Some of these characters have monuments dedicated to them, as if they were national heroes, like the giant moving statue of Gundam in Ōdaiba, Tokyo. Meanwhile, real robots, especially the humanoid ones, are treated as national symbols to be showcased to the rest of the world, like SoftBank's social robot Pepper[14], which appears on a promotional video of the Japanese National Tourism Organization (JNTO) welcoming tourists and displaying the national flag[15].

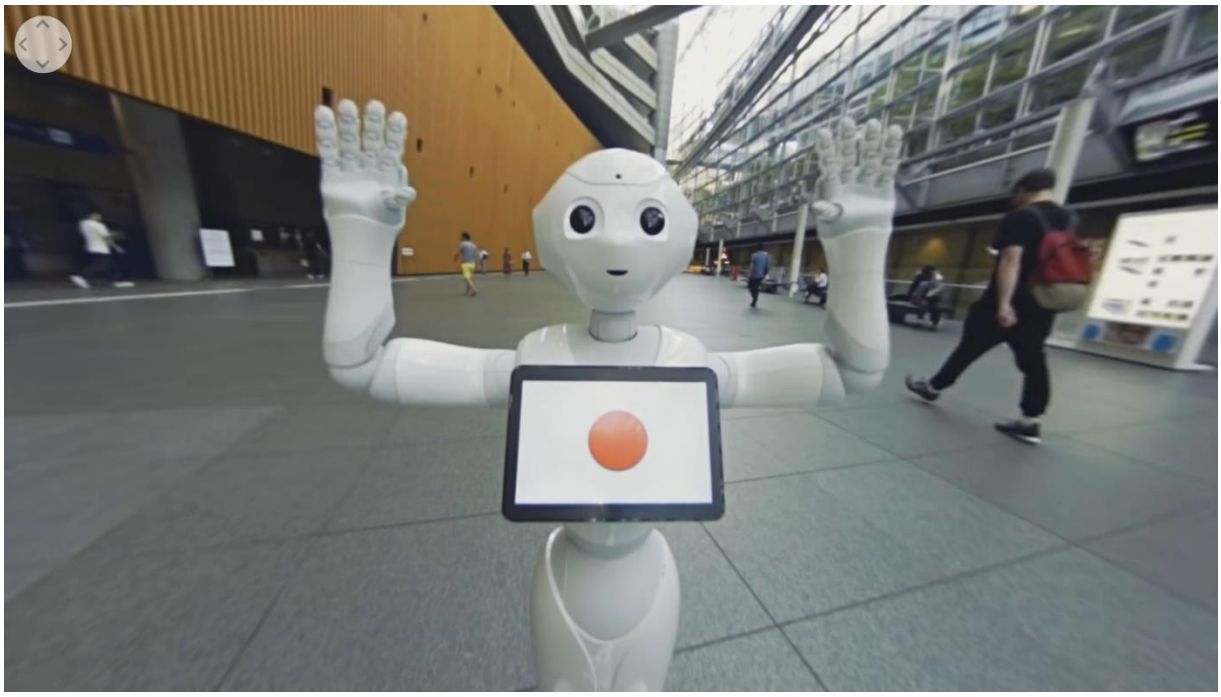

Figure 2: SoftBank's robot Pepper welcoming tourists and displaying the Japanese national flag. © Japan National Tourism Organization

[13] Schodt, *Inside the Robot Kingdom*, Kindle.
[14] "Meet Pepper: The Robot Built for People", SoftBank Robotics America, accessed December 15, 2022, http://us.softbankrobotics.com/pepper.
[15] Japan National Tourism Organization (JNTO), "[360°VR] JAPAN - Where tradition meets the future", YouTube, January 16, 2018, 1:22, https://www.youtube.com/watch?v=OR_Y7vj66PU.

Abroad, the effects of this projected image of Japan are most visible in its representation in science fiction, especially of north-American origin. The country has colonized an entire sub-genre, cyberpunk, to the point that is intrinsically inseparable from the use of *japonaiserie* as an aesthetic feature. A branch of critical studies, techno-orientalism, emerged precisely to study how Japan and other Asian countries came to be crystallized as signifiers of highly-technological imagined futures in SF and other media[16]. Commentators have pointed out that "The science fiction trope most commonly associated with the Japanese is that of the robot, the machine, the cyborg […]"[17], and that the invasion of US markets by Japanese toy robots was instrumental in shaping this imaginary[18].

1.3 The Japanese love of robots

Since Japan came to prominence in the field of robotics in the early '80s, a number of explanations have been given to the surprising diffusion of robots in the country and to the special relationship that Japan seems to have with this technology, sometimes referred to as "the Japanese love of robots". In this section I will present the cultural factors that are most commonly invoked in mainstream and academic discourse, along with a review of the previous literature that analyzed them critically. These can be broadly divided into two categories: those that propose endogenous factors to explain the predominance of robotics in Japan and those that stress the constructedness of this image of the country. To complement this, I will discuss briefly the previous literature of studies that have tried to demonstrate a preference of the Japanese for robots through cross-cultural analysis.

1.3.1 The Japanese love of robots: endogenous cultural factors

In the discourse about the preference for robots of Japan, the most common line of thought is that there must be a cultural difference which makes the Japanese more inclined to accept robots. The cultural traits pointed out as the reason for this are varied, but share a common trait: they are presented as intrinsic aspects of Japanese culture that are immutable, were already present before the arrival of robotic technology, and conditioned its acceptance in Japan. Culture is seen as an invariable substrate for the development of technology. I define these as explanations

[16] For a comprehensive discussion of techno-orientalism, see the preface in: David Roh et al., *Techno-Orientalism: Imagining Asia in Speculative Fiction, History, and Media* (New Brunswick: Rutgers University Press, 2015).
[17] Joshua La Bare, "The Future: 'Wrapped... in That Mysterious Japanese Way'", *Science Fiction Studies* 27, no. 1 part 2 (March 2000), p. 23.
[18] Ron Tanner, "Toy Robots in America, 1955-75: How Japan really Won the War", *Journal of Popular Culture* 28, no. 3 (Winter, 1994).

through “endogenous” cultural factors, where the endogenous means intrinsic to Japanese culture, as opposed to the “exogenous” element embodied by robots as foreign technology.

A first set of explanations calls upon various religious or philosophical aspect of Japanese culture that would make it more propense to the acceptance of robots. Often quoted is the indigenous Shinto, a diversified group of animist beliefs centered on the worship of *kami* 神, spiritual entities that inhabits all things organic and inorganic. According to this reasoning, the belief that *kami* can be present even in technological objects like robots makes possible to perceive them as a natural part of the world that can be even sanctified. A similar argument is made for Buddhism: many Buddhist thinkers believe that the nature of Buddha, the state of enlightment, can be found in every sentient being, and even in insentient matter; this would apply to robots too, as argued by Japanese roboticist Mori Masahiro[19]. Frederic Kaplan compares Western and Japanese mythology, and theorizes a fundamental difference in the concepts of “natural” and “artificial”. In Western myths, defining the boundary between the natural and the artificial is crucial: man is seen as the peak creation of nature, a perfect machine, while technology is an imperfect reproduction of nature made by man, a challenge to nature bound to fail if *hybris* prevails, as in the Prometheus myth. In Japanese mythology and classic culture, artificiality is seen as a positive element, coexisting with nature: in the myth of Amaterasu, the goddess of the sun is brought out of the cave to bring light to the natural world through a staged party[20]. Instead of opposing the artificial versus the natural, man versus nature, or man versus robot, the Japanese would link them harmoniously in a network of relationship; the artificial reproduction of nature, as in Japanese gardens, is the natural consequence of the interaction of man with the other natural elements. Robert Geraci argues that, in general, both Shinto and Buddhism have a positive view of physical existence, in which there is no division between material and spiritual life, in contrast to the Abrahamic religions of the West, in which man and nature are seen as antipodes, the material body carries with it the original sin and spiritual life is the true existence. In the West, robots are seen as objects crossing boundaries between life and death or human and inhuman, and thus often seen as sacrilegious objects. On the contrary, Japanese religions celebrate and sanctify material objects, as exemplified by the Shinto offerings that workers at Kawasaki factories tributed to industrial robots in the early ‘70s,

[19] Wayne Borody, “The Japanese Roboticist Masahiro Mori’s Buddhist Inspired Concept of “The Uncanny Valley” (Bukimi no Tani Genshō, 不気味の谷現象)”, *Journal of Ethics and Emerging Technologies* 23, no.1 (2013).

[20] Frederic Kaplan, “Who is Afraid of the Humanoid? Investigating Cultural Differences in the Acceptance of Robots”, *International Journal of Humanoid Robotics* 1, No. 3 (2004).

or by the Buddhist funeral celebrated for objects like dolls and even robots.[21] For Geraci, this would also explain the Japanese robotic engineers' supposed "fixation" with building humanoid robots and their preference for hardware over software, as opposed to American engineers, which had been already highlighted by Schodt[22], although Mori argued exactly the opposite through his famous theory of the uncanny valley, which states that humans tend to find repulsive objects that are alien as well as excessively human-like ones.

Another common explanation is that the representation of robots in popular culture shaped their reception in Japan. According to this argument, robots have been depicted as friendly and as allies in Japanese popular media, especially manga and animation, while in the West they are usually seen as antagonists and monsters epitomized by the Frankenstein's monster. The characters usually considered as emblematic of this positive representation are Atom and Doraemon. Atom, or Astroboy as it is better known in Western countries, is the protagonist of the manga-series *Tetsuwan Atomu* (鉄腕アトム, "mighty Atom") created in the '50s by Tezuka Osamu (1928-1989), often considered as the father of manga and the most influential comic author in Japan. This series itself is one of the first commercial hits in the history of manga industry and one of the first to be adapted into an anime; it played a fundamental role in shaping the early history of the media and it is still popular today. Atom is a mechanical kid created by Dr. Tenma, a scientist aiming to recreate a robotic version of his son who died in a

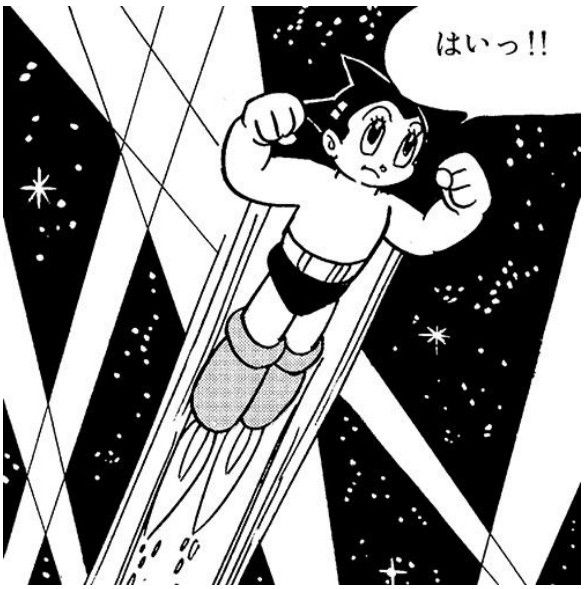

Figure 3: Atom

[21] Robert M. Geraci, "Spiritual robots: Religion and our scientific view of the natural world", *Theology and Science* 4, No. 3 (2006).
[22] Schodt, *Inside the Robot Kingdom*.

car accident. Realizing that the robot will never be his true son, the scientist heartlessly sells Atom to a circus. While the story begun as a dark, modern version of Pinocchio, in later chapters the mechanical kid, gifted with incredible powers thanks to the technologies of his robot body, goes on to become a hero fighting for the peace of Japan under the guidance of the Ministry of Science. Scholars of the topic of robot in Japan have noted that many Japanese roboticists and scientists quote Atom as their first inspiration to become an engineer, and some, especially those working on humanoid robots, go even further in saying that, with their projects, they are trying to rebuild Atom.

If Atom exemplifies the robot-as-hero, who fights for justice and ideals, Doraemon is the robot-as-helper: created in the '70s by the duo collectively known as Fujiko Fujio, it is a robotic cat that comes from the future to help the clumsy and lazy schoolboy Nobita by giving him technological gadgets that he materializes from his four-dimensional pocket. The kid, however, inevitably gets carried away in the use of the gadgets, leading to unintended and humorous consequences, and learning important life lessons in the process: it is a children's story of friendly technology that also warns of the dangers of relying too much on it.

Figure 4: Doraemon and Nobita
© Fujiko Pro – Shōgakukan – Tv Asahi

Doraemon can also be said to embody two other characteristics that are peculiar of Japanese service robots: the cute appearance and the lack of a clear utilitarian function. Indeed, Doraemon is a pet robot and a companion, but safe for providing company and teachings he doesn't do much else, and his gadgets usually end up doing more evil than good, as mentioned earlier. This reflects, in a cartoonish way, what is often described as the typical approach of Japanese robotics to service robots, which values aesthetics over practicality. Doraemon has

even been suggested as a possible "template" for socially assistive robots appropriate to Japanese society[23].

The success and impact on popular culture of these robot-characters is undeniable, but it must be noted that robots are not univocally represented as positive characters in Japanese popular culture: in her work on mechanical uncanny, Miri Nakamura points out that, in the context of early Japanese science fiction, "Machines and technology in prewar Japan […] did not simply represent social progress; they also were associated with fear and degeneration"[24]. Examples of threatening robots are not only found in early science fiction but in modern works as well, as I will show in later chapters. While positive robot characters are for sure among the most popular, we must not misunderstand this as the proof of a univocally positive depiction; if anything, the *reason why* positive characters are the most popular should be questioned – and the answer usually falls back in the first category of explanations that I described, or on historical circumstances.

A third argument points out at the history of robots in Japan. In essence, the argument states that robots are a "natural" presence in Japan because they descend from indigenous artifacts, the *karakuri ningyō* (からくり人形, "mechanical doll"). *Karakuri ningyō* are mechanical dolls that were built in Japan during the Edo period (1603-1867). At the time, the ruling Tokugawa shogunate had closed the borders and prohibited almost any contacts with abroad countries; the

Figure 5: Cha-hakobi ningyo 茶運び人形 (Tea-serving Boy)
Source: The British Museum

[23] Robert C. Marshall, "What Doraemon, the Earless Blue Robot Cat from the 22nd Century, Can Teach Us About How Japan's Elderly and Their Human Caregivers Might Live with Emotional Care Robots", *Anthropology and Aging* 37, No. 1 (2016).
[24] Miri Nakamura, "Horror and Machines in Pre-War Japan: The Mechanical Uncanny in Yumeno Kyūsaku's Dogura Magura", in *Robot Ghosts and Wired Dreams: Japanese Science Fiction from Origins to Anime*, ed. Cristopher Bolton et al. (Minneapolis: University of Minnesota Press, 2007), p. 6.

trading post of the Dutch East India Company (*Verenigde Oost-Indische Compagnie*) in Nagasaki was one of the few exceptions, and served as the only contact with Western culture, science and technology for almost two centuries and a half. Japanese artisans studied clockwork mechanisms and reproduced them with the available materials (including whalebone to replace cast iron). Alongside clocks, they started to create mechanical dolls for entertainment, capable of complex automated actions including serving tea, shooting arrows or performing dances. Initially, *karakuri ningyō* were produced for the entertainment of nobles, but at the peak of their popularity, there were several theaters displaying the mechanical dolls on stage for the public.

At the end of the Edo period, when the Tokugawa shogunate collapsed and the country was forced to open its borders and its markets to the Western powers, one of the masters of *karakuri* making, Tanaka Hisashige (1799 – 1881), became a leading figure in the process of modernization and industrialization that the country underwent. Due to his extensive knowledge of *rangaku* (蘭学, literally "Dutch studies", meaning the study of Western science and technology through Dutch texts), he was hired by the new establishment to help in the development of industrial technologies like steamboats and telegraphs, and went on to found a company that would later become today's Toshiba. According to proponents of this argument, like roboticist Suematsu Yoshikazu, *karakuri* masters mediated between the foreign technology and the indigenous ingenuity and creativity, adapting them so that they were "suited to the unique Japanese culture and people"[25]; in practice *karakuri* differed from the Western automata in that they were made for large public audiences rather than just for the pleasure of nobles, and that they were designed following Japanese formalism and not Western naturalism – similarly to the actors of Noh theater, they played with the viewers expectations in a formalized context to convey emotions with subtle movements, rather than trying to reproduce realistic movements. The popularity of *karakuri* and the fact that they were developed over the course of two centuries to appeal to the taste of the Japanese public would explain why, in the 20th century, the Japanese were so apt to accept industrial robots. However, the main fault of this argument is that the *karakuri* had been almost forgotten by the time modern robots came to Japan, and it was in fact only the diffusion of robotics that sparked a renewed interest for the ancient mechanical puppets[26].

[25] Suematsu Yoshikazu, *The Japanese Love of Robots*, accessed January 13th, 2023, https://web.archive.org/web/20190416094002/http://karafro.com/karakurichosaku/JapLoveRobo.pdf, p. 2.
[26] Schodt, *Inside the Robot Kingdom*.

1.3.2 The Japanese love of robots: "constructionist" explanations

In the last two decades, the aforementioned explanations have been challenged by several critical studies, which have instead argued that the "Japanese love of robots" is a constructed idea. This perspective, which I define as "constructionist", does not reject the importance of the aforementioned cultural factors, but stresses that of powerful actors in constructing the idea of Japan as country that easily accepts robots. Furthermore, they argue that culture is re-constructed and reinvented through the inclusion of technology itself.

Cosima Wagner is critical of far-too-simple explanations by endogenous factors and points out the role of media, experts and government in "engineering" an optimistic view of robots[27]. For example, with regards to the importance of Atom for Japanese robotics, she argues that Tezuka was compelled by his publishing house to give a positive view of technology when creating Atom, while the author wanted the manga to be more a critique of discrimination and a pessimistic depiction of contemporary society. As for *karakuri*, she describes the rediscovery of the long-forgotten mechanical dolls in the '60s by the scholar of history of technology Tatsukawa Shōji as his attempt to "disprove the common Western accusation of Japanese engineers as pure 'copy cats' of Western technology"[28], further amplified by media coverage. In both cases, the media played an important role in diffusing a positive view of robots, catering to a public eager to regain self-esteem after the defeat in World War II had highlighted Japan's technological inferiority.

Another analysis of the role of media, experts and institutions in promoting robots is found in Jennifer Robertson works[29]. While mostly acknowledging endogenous factors such as religion and positive representation in anime and manga, she points out at how the aforementioned actors build upon them to advance a positive image of robots which is fraught with ideology. By critically analyzing texts such as governmental science fiction, publicity materials for policies or promotional events and the likes, she uncovers how they often frame robots as a "*retro*-technology" that enables them to imagine a future vision imbued with conservative values, traditionalism, sexism, ableism and essentialism.

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[27] Cosima Wagner, "The Japanese way of robotics: Interacting 'naturally' with robots as a national character?", in *Proceedings of the 18th IEEE international symposium on robot and human interactive communication (RO-MAN 2009)* (New York: IEEE, 2009).
[28] *Ibid*., p. 511
[29] Jennifer Robertson, *Robo Sapiens Japanicus*.

Selma Šabanović has analyzed practices and discourses of engineers and roboticists, to show how they interpret and utilize culture to give meaning and justification to their work.

> Robotics in Japan has become identified with a vision of robots as social agents and personal technologies that will be easily accepted by society. In the development of this vision, scientists incorporate and adapt traditional themes and cultural values into advancements in robotic technology to suggest cultural continuity and support techno logical development.[30]

Describing the practices of robot-makers and researchers linking their robots to traditional crafts and arts that risk disappearing, like silk weaving or folk dances, Šabanović frames technology and culture in a relationship of co-production, arguing that not only culture is used to promote robots and influence their development, but that robots themselves are imagined as a technological mean to preserve both existing cultural modes and invented traditions, as a response to social changes. While acknowledging the need for technologies to negotiate with cultural and social structures, she, like Robertson, is also wary of the risks of "essentialism, stereotyping and exclusion reinforced by technological means"[31] if the cultural view of technology is not supported by critical reflection, as it may be biased because of the researchers' assumptions.

Mateja Kovacic analyzes the construction process of robot genealogies and histories by large corporations and governmental institutions[32]. She argues that these powerful actors, in their discourse, are creating linkages between robots (and other contemporary technologies) and the past through *monozukuri* (ものづくり, also written as モノづくり or 物作り, literally "thing-making", usually translated as "manufacturing" or "artisanship"), a concept which emerged in the '90s in the wider context of *nihonjinron* (日本人論, "theories/discussion about the Japanese"), a set of essentialist theories seeking to emphasize the uniqueness of Japanese culture. *Monozukuri* defines the peculiar and unique Japanese way of making things; in the words of Kovacic:

> By encompassing ideas of traditional artisanship, industrial manufacturing, and technological development, *monozukuri* emphasizes the cultural and national lineage of

[30] Selma Šabanović, "Inventing Japan's 'robotics culture': The repeated assembly of science, technology, and culture in social robotics", *Social Studies of Science* 44, no. 3 (2014), p. 359.
[31] *Ibid.*, p. 360.
[32] Mateja Kovacic, "The making of national robot history in Japan: monozukuri, enculturation and cultural lineage of robots", *Critical Asian Studies* 50, no. 4 (2018).

> manufacturing as the core of technological progress. Recently, the term "DNA" has been added to *monozukuri* […]. Monozukuri DNA signifies the organic cultural lineage of Japan's manufacturing tradition as well as innovative excellence, social continuity, and homogeneity of products based on artisanship that is transmitted generationally[33].

By using *monozukuri* in their discourse to genealogically link robots and other technologies to traditional arts and crafts, like the aforementioned *karakuri ningyō*, corporations and institutions are able to promote new technologies while preserving traditional ideas and concepts about Japaneseness, which are used both to assert the nation uniqueness on the international stage and to inscribe robots and new technologies with normative values that preserve the status quo.

Another hypotesis which is assimilable to those that I defined "constructionist" explanation is that of the positive feedback loop in robotics:

> […] Japan is experiencing a positive feedback loop in robotics related to how commitment and expertise function in organizations and economies. Once Japan acquired expertise in robotics, developed robots for factory automation, and trained a substantial number of robotics engineers, these experts began to create additional markets for their skills.[34]

According to this hypothesis, in short, the propensity for life-long employment typical of Japanese companies in the economic-boom period resulted in a favorable position for robotics engineers compared to that of their abroad colleagues, which are often forced to change several positions and are more likely to focus on other fields like management than working solely on robotics. The subsequent popularity of the career resulted in a disproportionately large number of robotics engineer whose collective action is influencing the discourse on robots and shaping a robot-friendly culture to make their job indispensable for society.

Finally, all the aforementioned scholars note that, in Japan, robots are framed as being an inevitable introduction into society due to the shortage of workforce accentuated by the super-aging of society. Academically, there is much debate on whether the introduction of robots and other automation technologies will effectively result in a net job loss or gain in the long run, with both pessimistic and optimistic view. To my understanding, in Western countries' public discourse robots are often seen as a potential threat to the workforce, leading to rationalization and loss of jobs; the issue seems to be less present in Japan's public discourse. The country's

[33] *Ibid.*, p. 575.
[34] MacDorman et al., "Does Japan really has robot mania? Comparing attitudes by explicit and implicit measures", *AI & Society* 23, no. 4 (2009) p. 504.

chronical shortage of workforce and low unemployment rates are convincing explanation for this lack of concern. Furthermore, Robertson insists on the Abe administration's efforts, backed by popular consensus, to promote robots as an alternative to migrants: "the corporate sector and government are banking on the robotics industry to reinvigorate the economy and to preserve the country's much eulogized ethnic homogeneity[35]".

1.3.3 Does Japan really love robots? Cross-cultural analysis

Inevitably, a question arises from the analysis of the discussions about the Japanese preference for robots: is it true that Japan love robots, or is it just an assumption? Numerous researches have tried to answer it through cross-cultural analysis, comparing the attitude of people from Japan with that of other nationalities through surveys and questionnaires, and employing both qualitative and quantitative approaches. However, there is no single definitive answer.

A consumer survey conducted by the Nomura Research Institute reveals that levels of acceptance for robots are similar between Japan, US and Germany, with US people being the most enthusiastic and those with more previous experiences with robots. Japanese respondents are more favorable towards the use of care robots, and more inclined to think that their job could be replaced by robots[36].

As for academic researches, the following are just a few examples. Studies by Bartneck and others have contradicted this assumption, showing that, in general, people from US have the most positive attitude towards robots, but Japanese score higher than other European or Latin countries, and that the Japanese are more concerned about the potential disruptive effects of robots on society[37].

A study from MacDorman and others values the attitude of Japanese and US university students through both explicit and implicit measures and finds that the group share more similarities than differences. While the Japanese have more experience with robots, they express only a slightly warmer feeling towards them, and both groups prefer people to robots; furthermore, both groups explicitly find human more threatening than robots, but implicitly associates robots to weapon more than humans[38].

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[35] Jennifer Robertson, *Robo Sapiens Japanicus*, p. 123.
[36] Nitto Hiroyuki et al., "Social acceptance and impact of robots and artificial intelligence: findings of survey in Japan, the U.S. and Germany", *NRI Papers* 211 (New York: Nomura Research Institute, 2017).
[37] Christoph Bartneck et al., "The influence of people's culture and previous experience with AIBO on their attitude towards robots", *AI & Society* 21, no. 1-2 (2007).
[38] MacDorman et al., "Does Japan really have robot mania?".

Nomura finds that Japanese people have a more positive attitude towards robots than UK people, and that the Japanese are more concerned about ethical issues associated to robots than EU or US people, but, together with Germans, far less concerned about potential loss of jobs, unlike French or Americans[39].

A study from Haring and others finds that European and Japanese do not differ greatly in terms of positive or negative attitude towards robot, although there are a few points on which the two differs in terms of expectations and fears: both have a pragmatic view of robots and want them to assist in the daily life, but Europeans seem to prefer robots performing house chores, while Japanese are interested in eldercare or childcare; both share similar fears about robots in terms of malfunctioning, possible damage to humans and the likes, but only Europeans are consistently concerned with the potential loss of jobs, and only Japanese with the potential misuse of robots. Interestingly, while both groups seem to have previous experience with robots through media, the Japanese are more exposed, but few of them have encountered a robot in real life, contrary to Europeans[40].

What do we understand by looking at these studies? First, we should note that they all have limits: the samples are usually quite small and not necessarily representative of an entire population; participants typically have to answer questions about either one single robot or a general concept of "robots", so the object of the surveys might be too general or too specific. However, there are some trends that undeniably emerge from them. First of all, there are clearly differences in how people from different nations perceive robots, especially about what they expect from them. Secondly, contrary to the narration of a "Japanese love of robots" that we discussed above, Japanese people do not seem to have remarkably higher acceptance of robots than people of other nationality; on the contrary, attitude towards robots seems to be relatively positive in all the countries surveyed, albeit with small variations – US people seems to be the most enthusiastic, followed by the Japanese, indicating that countries with a long tradition of being at the forefront of technological innovation are, quite predictably, more open to new technologies. Third, the differences between countries that are usually grouped as "Western" suggest that the attitude towards robot is not articulated on a simple dichotomy between East and West, but on more complex factors that might include historical background and

[39] Tatsuya Nomura, "Cultural Differences in Social Acceptance of Robots", in *Proceedings of the 26th IEEE international symposium on robot and human interactive communication (RO-MAN 2009)* (New York: IEEE, 2017).
[40] Kerstin Sophie Haring et al., "Cultural differences in perception and attitude towards robots", *International Journal of Affective Engineering* 13, no. 3 (2014).

socioeconomic structure of countries. Finally, one thing that emerges clearly is that Japanese people are more exposed to robots, although mainly through media and not real experience. This supports the "constructedness" hypothesis: it would seem that robotics technology is strongly hyped, spectacularized and discussed in Japan, in contrast to a relatively low diffusion of robots in the everyday life of citizens. This is consistent with the peculiarity of Japanese service robot sector, which historically has been oriented more towards academic research about humanoid robots or therapeutic robots and less towards robots as home appliances. Likely, this exposition to robots through media is also the cause for the Japanese being the most concerned about potential disruptive effects of robots on society: not only are they more aware of the potential issues that they may raise, but also have a more pragmatic and nuanced view about those issues that is not focused on job loss as the major concern.

1.4 Robots as objects of social study

So far, I have described what a robot is and the volatility of its varied definitions, the context of Japan as a highly roboticized nation, and the existence of a discourse which presents Japan as a country which loves robots. Through the review of previous literature, I showcased the critical perspective of scholars that have highlighted the constructedness of this discourse. A review of the cross-cultural studies aimed at proving a more positive attitude towards robots among Japanese have discounted this assumption, seemingly confirming the hypothesis that "the Japanese love of robots" is, at least in part, a constructed idea.

Perhaps surprisingly, I have discussed a lot of what people think about robots, and very little about how robots work or how they are made. This is most certainly because I do not possess the technical knowledge to do that, but also because the point of these thesis is to investigate robots from the perspective of social studies. How does a technology fits into the study of society? I believe that the previous sections show that nicely. The fact that the definition of a robot can change from person to person and that there are so many discussions about our relationship with robots raise one important point: robots are not simply tools built with a clear purpose; rather, their development and diffusion are processes that involve many different actors, each with its own view of what a robot is, or ought to be. To some, it is a product to sell, to others a solution to a problem, to others still, even a symbol of national pride. In other words, as robots make their way into society, they gain different meaning in the view of different people, meanings which are then shared and reorganized collectively. This way, robots change in interaction with society, and in turns spark societal changes, and only through this process they found a place in it. It follows that, investigating what we think and say about robots (or

any other technology), what we think they are or ought to be, one can find profound insights about what we think about society and how society ought to be. This is true both of real, concrete, robots and of imagined ones, perhaps even more so[41].

This brings to the main research questions of this elaborate. How does the social context influence the development of robots in Japan? Why are institutions, companies and other actors trying to build a collectively shared idea of a nation that loves robots? How do they envision future society and what role does robots play into it? How do they dialogue with other social actors – citizens, companies etc.… – to foster their vision? As briefly stated in the previous paragraphs, a recurring answer found in previous literature is that robots are a convenient solution to the problems of a super-ageing society like the Japanese one. I expand on this view focusing on the role of institutional actors in promoting and influencing the production of technology through the creation of imaginaries. My research, as already stated, will focus mainly on service robots, in particular social and care robots, and will cover the last two decades. The reason for this choice is that while industrial robots are a well-established technology, while service robots are relatively new and subjected to continuous discussion. As my aim is to uncover visions of the future, service robots are a better suited site of enquiry.

1.4.1 Theoretical framework

The notion that technological objects should be understood as immersed in a network of social relationship is well established in the field of Science and Technology Studies (STS). While a conventional narration of science and technology sees it as the product of the activity of scientists and engineers, STS emphasizes the role of society as a whole in shaping technology, bringing to light the role of non-scientific actors. The basic assumption is that even the most innovative discovery or invention would go unnoticed, or would have no meaning, if it wasn't for a collective effort of society to realize it, give it sense and reorganize itself around it. Cars, for example, couldn't exist without companies that produce them or consumers that buy them, without roads to drive them and without laws to regulate their use. At the same time, society cannot exist in its present form without technologies and scientific knowledge that organize it: the two must be understood in a relationship of mutual production.

[41] Ito, Kenji 伊藤, 憲二, "'Robotto no kagakuron' no tame ni: sono tenbō to kanōsei"「ロボットの科学論」のために: その展望と可能性 [A Preliminary Study for the Cultural History of Robotics in Japan], *Tetsugaku – kagaku-shi ronsō* 哲学・科学史論叢 vol. 5 (2003).

There are several valid approaches to the study of technology under the perspective of STS; in this work, I draw on the framework of "sociotechnical imaginaries", which has been proposed by Sheila Jasanoff and Sang-Hyun Kim, initially to analyze the differences in development of nuclear-power technologies in the US and South Korea. In their paper, Jasanoff and Kim describes the US policy about nuclear power as "Atoms for Peace", an imaginary born from the mix of the citizens' desire for security and the industrial-military complex need of containing the foreign nuclear threats during the Cold War era; the focus of this imaginary on the containment of the atomic menace led to a slower development of the nuclear-power industry, contrary to South Korea, where the shared imaginary, described as "Atoms for National Development", focused on building nuclear power plants to fuel the country's economic growth, and achieved an advanced industry leader in technological innovation[42].

The most comprehensive definition of sociotechnical imaginary given by Jasanof is the following:

> […] collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology[43].

The notion of sociotechnical imaginaries has at its core the importance of imagination: it stresses how technologies are first imagined and then created according to what society think its desirable from them (and conversely, what must be avoided). This explains why fictional account of technology (like the imagined robots of popular culture that I discussed in previous paragraphs) often precedes real technology. It also explains why the same technology can develop along different paths in communities which share distinct sets of values. In this elaborate, I find the concept to be extremely useful to take into account the cultural factors I discussed in paragraph 1.3.: through the framework of sociotechnical imaginaries, I seek to reach an understanding of these cultural factors that sees them not as intrinsic elements that deterministically condition the development of technologies, but as shared ideas upon which social actors involved in the development of technology build to create their imagined vision of future.

[42] Sheila Jasanoff and Sang-Hyum Kim, "Containing the atom: sociotechnical imaginaries and nuclear power in the United States and South Korea", *Minerva* 47 (2009).
[43] Jasanoff, "Future imperfect: science, technology and the imaginations of Modernity", in *Dreamscapes of modernity: sociotechnical imaginaries and the fabrication of power*, ed. Jasanoff and Kim (Chicago: The University of Chicago Press, 2015), p. 4.

Sociotechnical imaginaries must be understood both as productive and normative. Attaching values to imagined technologies, they not only support the production of technology as well as the changes in the social structures necessary to the diffusion of that technology: at the same time, these values also restrict the scope of how technology should be used, and of what behaviors that are expected from actors in relation to technologies.

Furthermore, the concept is useful to highlight the role of governments and other powerful actors in giving direction to the development of new technologies. One of the main points of this framework is that actors involved in the social production of technology are not equal in their capacity of shaping a collective imaginary: governments, but also influential individuals and organizations, enjoy more visibility, symbolical power and resources to influence a collectively held vision of future. My hypothesis is that national institutions in Japan acted as "coordinators", developing a sociotechnical imaginary that connects the aspiration of robot-makers to what institutions themselves perceive to be the needs of society and the expectations of citizens.

1.4.2 Methodology

The framework of sociotechnical imaginaries is best applied to the analysis of the official discourse of the state about technology. This can be done through qualitative analysis of policies and promotional material. Important public events and representations of S&T in pop culture are also a useful object of analysis, due to the performative nature of shared imaginaries. I will mainly focus on these types of data, as this allows me to overcome the impossibility of conducting fieldwork or interviews due to geographical and temporal constraints.

Chapter 2

In chapter 1, I showed how the discourse on the Japanese love of robots is partially a constructed idea, or a set of shared ideas that robot-makers and other actors utilize to justify and give meaning to their actions. In this chapter, through the concept of sociotechnical imaginary, I will describe the role of government in fostering the social acceptance of service robots. To do this, it is first necessary to discuss the relationship between the State and S&T in Japan, describing the main actors involved and the shift in this relationship occurred after the so-called "lost decade" of the deflationary '90s. A description of the socioeconomical and political context is also needed. These will be provided in the first part. Having clarified those points, I will show how the sociotechnical imaginary about robots targeted at solving social problems, which I name "Robots for Revitalization", was born and evolved after the turn of the century, linking itself to economic policies – in particular, the "Abenomics" of former Prime Minister Abe Shinzo. This is done in the second part through an analysis of policies about robots in historical perspective. To complement it, I will provide an analysis of performative aspects of the sociotechnical imaginary.

2.1 Science, Technology and the State in post-bubble Japan

To discuss the relationship between S&T and the State in post-bubble Japan, I will cover three main points: a brief account of the role of industrial policies in coordinating research and development (R&D) in postwar Japan, before the deflationary period of the '90s; the change in S&T policies in the mid '90s; and its socioeconomical background. Here, my analysis aims at uncovering elements of continuity and differences in the State vision of S&T and in the organization of technoscience before and after the collapse of the bubble economy, to provide the necessary background from which I argue the sociotechnical imaginary about robots emerged.

2.1.1 Science, Technology and Industrial Policy before the bubble

Historically, the configuration of what in STS is defined as "technoscience" – that is, the network of relationship between scientific actors (scientists and engineers, labs and machinery…) and other non-scientific social actors (firms, the State…) that contribute to the production of S&T – and else as national innovation system, has been considered peculiar in Japan. In the second half of the 20th century, in the period going from the end of WWII in 1945 to the late '80s, the production of technoscience in the US, UK and other Western countries, as well as in the Eastern Bloc of Soviet countries, has been clustered around public spending in

military industry: only this sector, where the State allocated most of its huge R&D expenditure, could afford to invest on cutting-edge researches, whether in basic science or technological innovation, whose results, initially aimed at military prowess, were expected to eventually spill over to the civil, private sectors. Atomic energy for civil use, and the internet are notable examples of technologies that were initially developed for the military and later spilled over to the civil sector, creating new industries. On the other hand, Japan, where the postwar constitution imposed by the occupying Supreme Commander for the Allied Powers (SCAP) prohibited the establishment of armed forces, military-led S&T was not possible. Most of the R&D was done in the private sector, at the level of the firms, while public-funded research through national institutes and universities primarily covered basic and medical science.

However, this does not mean that the State had no role in R&D: on the contrary, it had a considerable power, mainly through the Ministry for Industry and International Trade (通商産業省, *Tsūshō sangyō-shō*, MITI) and its agencies, the National Institute of Advanced Industrial Science and Technology (産業技術総合研究所, *Sangyō gijutsu sōgō kenkyū-sho*, AIST) and the New Energy and Industrial Technology Development Organization (新エネルギー・産業技術総合開発機構, *Shin-enerugii sangyō gijutsu sōgō kaihatsu-kikō*, NEDO). MITI exerted his coordinating power working in close contact with the various industries' management, mainly through the establishment of government-sponsored consortia of industrial firms to perform R&D in cutting-edge fields where the private sector needed the government's support and vision.

The line of thought behind MITI's industrial policies was that S&T had to be the drive for economic development, through investment in R&D in strategic industries to catch-up with Western economies. The leading sector for investments, especially after the 1973 oil crisis, was the energetic one. It was in this period that NEDO and the first consortia were established, and that S&T came to be seen as a national resource in a country poor in natural resources: where oil was lacking, industries had to invest in R&D, to develop less-energy consuming techniques of production, and the government in nuclear power plants for energetic self-sufficiency. The leading role that the energy sector had is reflected on robots, both real and fictional. One of the first MITI-led consortia-projects involving robots, the *Kyokugen sagyō robotto purojekuto* (極限作業ロボットプロジェクト, "Project for robots operating in critical work condition"),

carried out between 1982 and 1989, was aimed at developing what I have defined in the first chapter as "robots for hostile environments", including those for operations in nuclear plants and radioactive areas. Moreover, Atom, the most popular Japanese fictional robot which I talked about in the first chapter, is named after the atomic reactor that powers his robotic body. Indeed, Atom is a symbol of the techno-optimistic attitude of postwar Japan, when the country, despite having suffered the atomic bombardment, saw in that same atomic energy the mean to recover its economy and catch-up with the West. The same attitude is largely superimposable with the sociotechnical imaginary described as "Atom for National Development" by Jasanoff and Kim; although their work refers to South Korea, the country's view of nuclear power was largely modeled on Japan's experience[44].

The role of MITI in coordinating the Japanese national innovation system between the '50s and the '80s has received conflicting judgement[45]. During the '80s it was often credited with the exceptional growth of the Japanese economy in the postwar years, but it was later harshly criticized and the importance of its industrial policies downsized. The large industrial projects in the energy sectors came to be associated with pork-barrel politics and corruption, and some R&D consortia resulted in lock-in on technologies that turned out to be obsolete. Eventually, by the end of the '90s, its influence on industry was shrinking and MITI was merged with other agencies to form the new Ministry of Economy, Trade and Industry (経済産業省, *Keizai sangyō-shō*, METI) in the context of a larger reform of central government. Discussing MITI's importance or merits in Japan's postwar economic growth is behind the scope of this elaborate. For my purposes, it is sufficient to highlight some elements of continuity that one must take into account in analyzing the creation of the sociotechnical imaginary about robots.

First, despite reduced influence, the new METI continues to play a role of coordinator of R&D through industrial policies, especially in those emerging sectors where R&D has high risks. This is most true for the service robot industry, where the R&D consortia it leads through NEDO became increasingly comprehensive and ambitious. Following a trend of centralization of power, METI is now backed up by special committees established by the Prime Minister's Cabinet, whose members come from academia, industry and the government itself, but the overall role of these institutional actors in the field of robotics is, in my view, largely unchanged,

[44] Jasanoff and Kim, "Containing the atom".
[45] See Hiroyuki Odagiri and Akira Goto, "The Japanese system of innovation: past, present and future", in *National Innovation Systems: A Comparative Analysis*, ed. Richard R. Nelson (New York: Oxford University Press, 1993), pp. 76-114.

and perhaps even stronger: it consists in mediating between the interests of the major firms and the macroeconomic objectives of the government, in setting directions and goals for R&D and providing a general vision of how the industrial sector should develop. Moreover, METI still coordinates many R&D consortia in the service-robots industry. The second point of continuity is the general vision of S&T. Science is still seen as a national resource, perhaps even more than in the high-growth era, although how it should contribute to the Nation's development has changed. In the next paragraph, I will describe the socioeconomical background of Japan after the collapse of the asset price bubble that resulted in that change.

2.2.2 The socioeconomical context in post-bubble Japan: economic deflation and super-aging society

Until the '80s, Japan was considered an economic superpower, or economic "miracle", and its industries were regarded as leaders in technological innovation in many cutting-edge fields like electronics and semiconductors. As it is well known, after the collapse of the asset price bubble in the early '90s the situation radically changed, economic growth leaving place to what was called "the lost decade". In this paragraph I will consider two major factors of the changed socioeconomical context: the deflationary spiral that invested Japanese economy and the demographic change known as ageing society. As both phenomena have been discussed in countless researches, my description here will not be detailed, for this, again, is beyond the scope of this elaborate; my concern is limited to pointing out how they sparked a relevant change in the relationship between the State and S&T.

During the '80s, Japan experienced a bubble in its asset prices, caused by the central bank policies that artificially increased the circulating currency and made easy for banks to lend money without bothering about the quality of the borrower. When the central bank was forced to raise interest rates, the prices of land and market stocks inevitably crushed, leaving many firms who had invested in those assets with a negative balance sheet. In this situation, many small firms became insolvent or eventually went bankrupt; most important for my analysis is that even those firms and corporations that managed to survive the crisis had to consider the non-operating loss they suffered. This made Japanese companies increasingly reluctant to make investments. The reduced internal demand, the failure of many companies and the consequent decrease in wages resulted in a deflationary spiral and economic depression.

It is also important to note that, while export has always represented a major strength for Japanese economy, a strong internal demand for consumers goods like electronic appliances

and cars had been in fact the main drive behind economic growth and the consequent investments of the manufacturing sector in R&D. In the '90s, not only the internal demand was lower, but these traditional markets were also becoming increasingly saturated. To find new demand, companies were forced to create new products and move into new business, like the emerging IT sector, but this required risky investments and strategic vision, contrary to the high-growth era when R&D was mostly about perfectioning already known technologies and focused on the improvement of production processes.

Central governments found themselves in a paradoxical situation: on one hand, they had to sustain the internal demand through public spending; on the other, its tax revenues decreased in pair with the stagnating GDP. In other words, the stability of the Japanese economy in the '90s and '00s has been sustained mostly through the increasing public debt.

This macroeconomic scenario has been further aggravated by the other change in the socioeconomical context that I am taking into consideration: the demographic trend of aging society. Aging society is a well-known phenomenon: over the course of the last decades, many industrialized countries throughout the world experienced an overall aging of their population, a phenomenon known as ageing society. Its causes are the rise in average life expectancy and the decline in birthrate. In Japan this phenomenon started to be particularly pronounced and rapid since the early '90s, in concomitance with the economic crisis, and today the country has the oldest population in the world and is sometimes defined as a super-aging society. The rise in the average life expectancy, in concomitance with the decline in birthrate, resulted the "65 years and over" (hereafter 65y+) age group increasing both numerically and proportionally. The

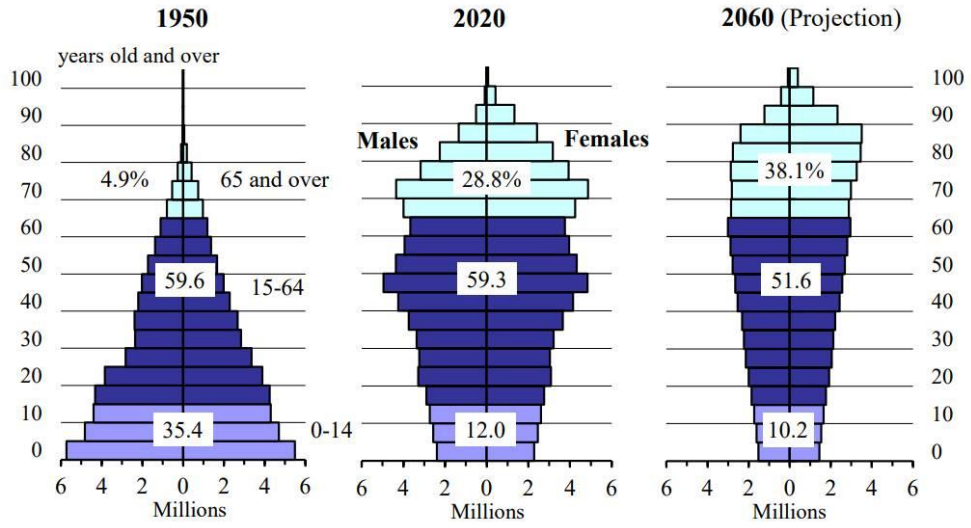

Figure 6: Population pyramid of Japan
Source: Statistic Bureau of Japan

age structure of the population changed drastically: as shown in Fig. 6, the population pyramid is narrowed at the bottom, highlighting a trend of declining population. In 2020, the 65y+ population was 36.19 million, and amounted to 28.8% of the total population; of those, 6 million live alone, and many are affected by chronic illnesses[46].

Aging society in Japan has been identified as a major drive for social problems. One is the care of elderly people: as the age expectancy increases, older people face an increased number of health issues, ranging from chronic illnesses to reduced mobility, which implicate more demand for long-term care. In Japan, traditionally, elderly care has been entrusted to relatives, especially female family members, but the increasing burden on families is in part responsible for the low occupation of women, decreased family income and low birthrate, leading to a vicious cycle. The 65+ group is also weighing on public finances, through the pension system and healthcare. It is the age group that spends more on healthcare, and their numerical increase poses an ever-increasing economic burden on the National Health System (NHS). The growing public spending for NHS and pensions is occupying an ever-growing percentage of the government's budget, limiting its capacity to invest without resorting to debt. Meanwhile, the decline in birthrate means that, as the older age group grow both numerically and proportionally, the active workforce is shrinking. A shrinking population and workforce also mean reduced demand and reduced incomes from taxation for the government, enhancing the threat to the financial stability of the pension system and NHS, and aggravating the deflationary spiral.

The demographic change also has a geographical dimension. Rural areas and peripheric prefectures far from the metropolitan centers are the areas with the highest concentration of elderly people and a decreasing population; at the same time, they lack infrastructures and services needed for eldercare. The trend of depopulation also leads to further economic stagnation in those rural areas and to the lack of workforce in strategic but low-productivity sectors like agriculture and fishing, where most of the workforce is aged.

All these socioeconomic problems triggered by the new demographic situation called for drastic reforms of the NHS, pension system and taxation system; but, as I will show, in the next section, they also pushed the Japanese government into reconsidering the role of S&T.

[46] Statistics Bureau of Japan, *Statistical handbook of Japan 2021*, accessed January 21, 2023, https://www.stat.go.jp/english/data/handbook/pdf/2021all.pdf.

2.2.3 The shift in Science and Technology policies at the turn of the century

The disastrous economic situation of Japan in the ’90s set in motion a transformation of the country’s political system, threatening for the first time in four decades the political hegemony of the Liberal-Democratic Party (LDP) and resulting in reforms to vast sectors of the administration. S&T policies where not an exception: in 1995 the government enacted the “Basic Act on Science and Technology” (科学技術基本法, *Kagakugijutsu kihon-hō*), a new law that for the first time advocated for a comprehensive management of S&T by the government. Its main starting points were two: first, the government was spending too little on R&D compared to other developed economies, and with the ongoing deflation the public sector had to invest more to support the troubled private sector’s investments on R&D; secondly, the old model of catch-up economy and industry-led research was not feasible anymore, so the government had to actively promote R&D through policies aimed at fostering collaborations between industries, academia and national institutions in order to make Japan a leader in technological innovation. The goal was to “contribute to Japan's socioeconomic development and improve the national welfare, as well as playing a role in global scientific and technological progress and the continued development of mankind”[47].

The most important effect of the law was that the government committed itself to creating and enacting quinquennial plans in order to give a systematic direction to national S&T policies both in the public and the private sector, defined as “Science and Technology Basic Plan” (科学技術基本計画, *Kagakugijutsu kihon-keikaku*). The ideology underlying the new law, clearly expressed in the first Basic Plan enacted between 1996 and 2000, is that of *kagakugijutsu sōzō rikkoku* (科学技術創造立国), literally meaning “foundation of the country by creation of science and technology” and sometimes equated with the concept of techno-nationalism. Here I provide a translation of a passage from the plan:

> There are strong concerns that Japan will face a state of crisis consisting in the hollowing of industries, loss of dynamism in the society, and decline in the standard of living, caused by globalization and the progressive disappearance of borders, by the intensifying international economic competition, and by the aging of our society that is progressing at a rate unprecedented in history. Moreover, in the future, humanity, including the people of

[47] Japanese Law Translation, “Basic act on Science and Technology”, accessed January 21, 2023, https://www.japaneselawtranslation.go.jp/en/laws/view/2761/en#je_ch1at1.

> Japan, will face many problems on a global scale, such as the environmental problem, food scarcity, and energy and resources problems. Furthermore, the consciousness and values of the Japanese people are shifting in the direction of emphasizing spiritual richness, so there is a strong need to build an affluent society in which people can live peacefully and safely. The expectations for science and technology to play a major role in addressing these various internal and external challenges are growing ever higher[48].

The plan goes on to describe the kind of society based on S&T that Japan must become. Without going too deep in details, I will summarize the main points of these ideology.

- Since Japan is poor in natural resources and its population is shrinking, its economy must be sustained by S&T, that must be recognized as the country's main asset.
- The goals of the production of S&T cannot be limited to industrial development and economic growth anymore. S&T must also address the peculiar social problems of Japanese society and the global ones.
- Japan is a forerunner in terms of social and environmental problems (aging society, high occurrence of natural disasters, lack of resources), but this weakness is also its strength. The country must be a leader and innovator in solving them, as the technological solutions it produces will be the key for its competitiveness on the international stage.
- The state must take an active role in promoting S&T, both through investments and by stimulating the interest of citizens.

One peculiarity of this new conceptualization of S&T is the idea of the responsibilities of science: in the plan, the words *anshin* (安心, "lack of worries"), *anzen* (安全, "safety") recur multiple times, showing the ambition for a responsible science which contributes to the collective good and mitigates risks, and the concerns for the negative repercussion that S&T had on society and the environment in the past. Deeply ingrained in this idea is also the refusal of its use for military purpose, which lies at the core of Japanese techno-optimism. Behind the genuinely altruistic and techno-optimistic propositions, there lies an autarchic desire for self-sufficiency and the nationalistic ambition for becoming a great power through soft-power and retaining the status of "Japan as n° 1" that the country enjoyed during the '80s. This nationalistic attitude has been addressed critically by Zappa in research concerning techno-nationalism in

[48] "*Kagakugijutsu kihon-keikaku*" 科学技術基本計画 [Science and Technology basic plan], MEXT (Ministry of Education, Culture, Sports, Science and Technology – Japan), accessed January 21, 2023, https://www.mext.go.jp/b_menu/shingi/kagaku/kihonkei/honbun.htm. I translated the quoted parts from Japanese to English.

the energetic sector, who points out the neo-colonialist stance behind some of its most ardent proposals[49]. The new policy of S&T as a "national interest" has also been criticized for putting too much emphasis on national projects and causing "*imaginary lock-in*" (non unlike the big projects of MITI in the earlier decades) in unproductive researches just for the sake for their "Japaneseness", as in the case of Mikami's study on the sociotechnical imaginary of regenerative medicine[50]. Similar concerns animate the debate on robots' imaginary, as I will show in the next sections.

The main tools that governments used in carrying out the next basic plans were the increased public spending; the fostering of industry-academia collaboration and government-sponsored consortia in the industrial sectors of national interest; the implementations of standards and deregulation of markets to facilitate the entrance of new products; and the promotion of S&T among citizens, to match their needs with the new technological results. Conceptually and methodologically, the ideology of *kagakugijutsu-sōzō rikkoku* was in continuity with the idea of S&T in the high-growth era. S&T was, and still is, not a goal in itself but a resource for the nation. However, it was now summoned out of the factories and into society. The new role of S&T in relationship to the State was the starting point for the emergence and development of the sociotechnical imaginary about service robots.

2.2 "Robots for Revitalization": a sociotechnical imaginary

This paragraph deals with the development of the sociotechnical imaginary concerning service robots that I conceptualize as "Robots for Revitalization". As main source for my discussion of the topic I will present an analysis in historical perspective of the main policies and projects concerning service robots from the late '90s to 2020. The second part conceptualizes and define the sociotechnical imaginary. A third part complements it with the description of performative aspects of this imaginary, through the analysis of governmental science fiction and public events.

2.2.1 Service robots in policies and projects

As already touched on earlier, in the latter half of the '90s METI started to sponsor increasingly comprehensive and ambitious technological projects on service robots, through its agencies NEDO and AIST and in collaboration with various firms. The first project was the Humanoid

[49] Marco Zappa, "Smart energy for the world: the rise of a technonationalist discourse in Japan in the late 2000's", *International Quarterly for Asian Studies* 51, no. 1-2 (2020).
[50] Koichi Mikami, "State-supported science and imaginary lock-in: the case of regenerative medicine in Japan", *Science as Culture* 24, no. 2 (2015).

Robotics Project (HRP, 1998-2002); aimed at creating humanoid robots capable of walking and reproducing human movements, it was expected to generate technological spillover with practical application. Humanoids, as I mentioned in the first chapter, had long been a dream of Japanese robotic engineers, and the HRP had notorious antecedents: researches on humanoids at Honda had started already in the '80s and the first ASIMO model was presented in 2000 – HRP was, in a sense, competing with ASIMO for the humanoid with the most advanced mobility. The project spawned two models (with more in later iterations), achieving undoubted technological advancements. It was a first small victory in proving the institution's capacity of affirming a strong strategic vision and fostering fructuous collaborations through national research institutes and the private sectors – the government-sponsored consortia have been proven to increase the research productivity of participating firms[51]. However, neither the HRP models nor ASIMO had commercial value, being too expensive and not having practical value. Humanoids seems to represent a case of *imaginary lock-in*: developed because of the prestige they brought to the nation and to firms, they ended syphoning resources while giving birth to negligible concrete results.

In the same period, researchers and firms independently experimented with another category of service robots with no immediate practical use: robot pets. In 1999, Sony released its first version of the robot dog AIBO, and in 2001 Takanori Shibata of AIST first exhibited to the public the robotic seal PARO, which later was tested as a therapeutic robot, got certified as a therapeutic tool in the US and spawned a huge corpus of research paper. However, neither these two robots had a great commercial success. AIBO was discontinued in 2006 due to being unprofitable to the company, and PARO, despite seeing use in medical structures in the US, EU and Japan, sold only 5000 exemplars in over 15 years. The biggest success of all these humanoid and animal-like robots, one could argue, was in promoting interest in robots and technology among general society: as I will show in later sections, many of them have been used to reaffirm and publicly perform the shared idea of robot-loving Japan.

The robot industry was quick in realizing that the current projects were in an impasse. In 2001, the Japan Robot Association (日本ロボット工業会, *Nihon robotto kōgyō-kai*, JARA), a trade association of robot-makers, published a report in which it lamented that, despite the boom of interest in humanoids and social robots, the real state of the industry was not so good. Japanese

[51] Sébastien Lechevalier et al., "The effect of participation in government consortia on the R&D productivity of firms: a case study of robot technology in Japan", *Economics of Innovation and New Technology* 19, No. 8 (2010).

companies in the field of robotics lacked competitivity outside the industrial sector; it was difficult to invest in other sectors because of the high risks, so R&D was limited to the public institutes, academia and government sponsored projects; however, these failed to deliver concrete results and the spillover of basic technologies was slow and ineffective. The associations also highlighted the mistake of considering robots as "objects" or "commodities" and the excessive focus on hardware among researchers, and proposed instead to conceptualize robots as "systems", aggregates of technologies connected through informatics and able to offer solutions. In any case, the association also stated its great expectations for the growth of service-robot market, expected to reach a volume of around 5 trillion yen (around 40 billion euros) in 2025, and pointed out several promising field, among which that of "life-support" (生活支援, *seikatsu shien*, meaning home-appliance robotics, chore robots and social robots) and welfare (or care robots). In doing so, it called for a stronger help from the government in providing a strategic vision and a favorable environment through projects aimed at concrete results, and the development of social infrastructures to facilitate the entrance of robots in markets, such as deregulation and taxation incentives[52].

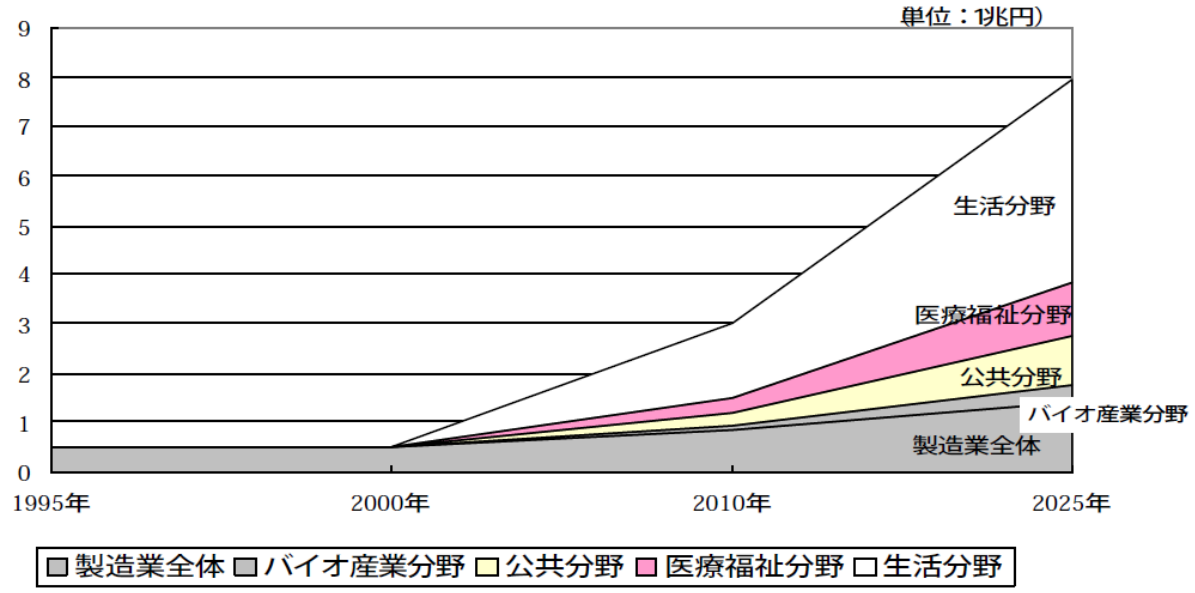

Figure 6: Expected growth of the markets for robots.
Source: JARA

The white part indicates "life-support" robots; the pink one care robots and medical robots; the yellow one "public service robots" (here meaning mainly robots for hostile environments); the gray parts industrial robots in the field of manufacturing and biotechnologies. The unit measure on the vertical axis is one trillion yen.

[52] JMF (Japan Machinery Federation) and JARA (Japan Robot Association), *nijūisseiki ni okeru robotto shakai sōzō no tame no gijutsu senryaku chōsa hōkokusho* ２１世紀におけるロボット社会創造のための技術戦略調査報告書 [Investigation report on technology strategies to realize a "robot society" in the 21st century], accessed February 3, 2023. https://www.jara.jp/various/report/img/rt.pdf

The government was quick in receiving the industry's plea: robot industry was included in METI's strategy for new industries, and a "Discussion Committee on Next-Generation Robots Vision" (次世代ロボットビジョン懇談会, *Jisedai-robotto bijon kondankai*) was established.

As already touched on earlier, this kind of committee emerged in the early 2000s as advisory organisms, backing up the bureaucracy as an intermediary body between the government and the interests of firms and civil society. The group, composed of experts from academia, firms and civil society together with observers from the ministries, released a report in 2005 titled "Towards a society where humans and robots coexist in 2025", which contains what is, in my opinion, the first evidence in policies of the developing sociotechnical imaginary about service robots[53].

The report identifies four main fields of future practical application for "next-generation robots":

- Manufacture and production: automation of agriculture and primary sector industries;
- Lifestyle: support to domestic chores, reception of guests in offices and public spaces, child-care and ensuring child safety during school commute;
- Welfare/Therapy: reduction of medical errors, support to the autonomy of those dependent on care, and support to caregivers
- Public: disaster preparedness, surveillance.

Robots are envisioned to provide solutions to three issues identified as priorities for Japanese society: the demographic problem (少子高齢化, *shōshi-kōreika*, "low birthrate and aging society"), risk mitigation (*anshin* and *anzen*), and the creation of opportunities of self-realization for everyone – expressed through the concepts of *benri* (便利, convenience, usefulness) and *yutori* (ゆとり, free-time, affordability, comfort).

The report, along the lines of the *kagakugijutsu sozō rikkoku* ideology, portraits service robots as an asset both for economic recovery and resolution of social problems, and creates interesting connections between these two goals. For example, new industrial robots and automation are

[53] Jisedai robotto bijon kondankai 次世代ロボットビジョン懇談会, *2025nen no ningen to robotto ga kyōzon suru shakai ni mukete* ２０２５年の人間とロボットが共存する社会に向けて [Towards a society where humans and robots coexist in 2025], accessed February 3, 2023, https://warp.da.ndl.go.jp/info:ndljp/pid/285403/www.meti.go.jp/kohosys/press/0005113/0/040402robot.pdf.

predictably seen as a solution to contrast the effects of *shōshi-kōreika* in the primary sector, in which the workforce is described as mostly aged and shrinking due to the unattractiveness of the position; similarly, care robots address the lack of caregivers in front of a growing population of elders in need of care; however, most interesting is how service robots for house chores and childcare are seen as a way to reduce the amount of care work required from housewives and creating more spare time and consequently, more possibilities for women employment, addressing at the same time the issues of *shōshi-kōreika* and *benri*/*yutori*. Furthermore, it is envisioned that care robots will make house chores easier to perform even for working husbands, resulting in a more even distribution of duties between spouses. Similarly, care robots for the support of elders' independence are expected to let aged workers continue to do jobs that necessitates physical skills for longer and postpone their retirement. In other words, service robots are intended to integrate in society and replace humans in care activities that are conceptualized as unproductive, or in sectors with low productivity, and let humans perform productive activities for longer and more efficiently, in order to secure a larger workforce in spite of the demographic loss the country is going to face; this is also expected to raise the GDP and raise international competitivity. In addition, service robots working in public spaces address the issue of safety and security (*anzen* & *anshin*) by patrolling, escorting children to school and helping in the response to natural disaster. Furthermore, the report recommends introducing safety standards, laws and regulation, to protect the privacy of citizens using robots, to solve controversies in the case of accidents caused by robots, and to prevent hacking and illegal use of robots. These commitments reflect the safety culture already expressed in the first S&T Basic Plan.

Finally, one more interesting point of the report is that it advocates for efforts by the government to promote the acceptance and diffusion of robots in order to nurture a society in which humans and robots can coexist, through the creation of occasion of familiarization with robots such as demonstrations held at public events. This recommendation was realized the same year with demos held at various events, the most important of which is the Aichi 2005 World Exposition (EXPO 2005), which will be touched on in the next section.

In the same year, a new committee, a "Research Committee for Robots Policies" (ロボット政策研究会, *Robotto seisaku kenkyū-kai*) was constituted to further investigate concrete measures to be taken in order for the robot market to expand, with particular attention to safety guidelines. Its final report, released in 2006 and titled "A revolution in robotics will make Japan leap

forward"[54] tackles the issue from a more realistic perspective. Despite sharing the same underlying vision – Japan must exploit its advanced robotic technologies and strength of its robotic industry to create new markets and raise international competitiveness – and positively judging the demonstrations held at various events, it warns of the difficulties in matching the needs of customers with existing robotic technologies to create profitable products: it argues that, as the rapid diffusion of industrial robots was made possible thanks to the collaboration between robot makers and the buying firms' production engineers, now robot makers have to cooperate with service providers to understand which kind of robots can be useful for the public.

The interplay between a techno-optimistic vision and a realistic concern with the marketability of the researches the government is funding indicates the ongoing negotiation within the developing sociotechnical imaginary between the expectations of institutionalized actors (the government and firms), the inclinations of citizens, and the real possibilities of the technology. Safety measures were an obvious site of negotiations between the government's desire for risk mitigation and the necessity to test the technology in a real environment and not a staged one. More interestingly, the insistence on concrete market possibilities of further R&D results suggests a concern of failing to involve consumers/citizens in the imagined vision of a robotic society that the government and firms were developing. In other words, the involved actors were aware of the possibilities of the imaginary to cause a lock-in in expensive and inefficient R&D. However, the positive feedback received by robots at the Aichi Expo 2005 further solidified the imaginary among institutions and firms.

Abe Shinzō, an influential politician belonging to LDP who was serving his first mandate as Prime Minister at the time (2006-07), was particularly fond of robots. Under his administration, a long-term strategy for R&D named "Innovation 25" (イノベーション 25, *Inobēshon 25*) was crafted in 2007. One more time, service robots recur in it as a solution for social issues and a drive for economic (re)growth, expected to lower the burden of care work on families, raise women and elderly's participation to society and guarantee society's safety and security. In particular, the reports of the "Innovation 25 Strategy Council" (イノベーション 25 戦略会議, *Inobēshon 25 senryaku-kaigi*) insist on development of care robots, on the "1 house-chore

[54] Robotto seisaku kenyūkai ロボット政策研究会, *Robotto seisaku kenkyūkai hōkokusho -RT kakumei ga Nihon wo hiyaku saseru-*ロボット政策研究会 報告書 ～RT 革命が日本を飛躍させる～ [Report of the study committee on robot policies: a revolution in robotics will make Japan leap forward], accessed February 3, 2023, https://www.jara.jp/various/report/img/robot-houkokusho-set.pdf.

robots for each house" idea, on security robots connected through ubiquitous sensor networks, and even propose to send a robot on the moon[55].

Abe resigned in 2007, but the Innovation 25 strategy survived until his comeback in 2013, after the defeat of the rival Democratic Party of Japan (DPJ) which was in part the result of the DPJ administration's not brilliant handling of the 2011 Tōhōku Earthquake and consequent nuclear disaster at the Fukushima Daiichi Nuclear Power Plant. Incidentally, the nuclear disaster also sheds light on the distance between the institutional depictions of robotic solutions and the real state of the technology and its acceptance in Japan at the time. Robots projected for such emergencies had existed in Japan but despite the efforts of institutions and robot makers, but clearly the proposed imaginary of robots was not shared by the management of energy companies, which deemed them unpractical and expensive, and eventually dismantled them or relegated them to a museum[56]. As a result, no robot in the country was able to get into the plant to perform inspections and other operations, and Japanese authorities had to resort to US military robots (with poor results) much to the disappointments of estimators of the Robot Kingdom[57]. However, rather than discouraging R&D in robots, the accident reinforced the conviction that investing in it was a necessity: as I will show later, Fukushima recently even became the site of a Robot Test Field.

Indeed, the new Abe administration became even more invested in robots, which became entwined with its flagship economic policy known as "Abenomics", launched in 2013. Abenomics' main features, described as its "three arrows", consisted of monetary easing, fiscal stimulus through public investments and structural reforms. While the most popularized feature of this macroeconomic policy was quantitative easing, one the underlying ideology at the foundation of Abenomics is that of *kagakugijutsu-sōzō rikkoku*. The growth strategy aimed at attracting foreign investments through the development of special economic zones where deregulation was in place to foster innovation; furthermore, Japan was again pictured as a forerunner in terms of problems which could also become opportunities, through strategic

[55] Inobēshon 25 senryaku kaigi イノベーション２５戦略会議, *"Inobēshon 25" chūkan torimatome -mirai wo tukuru, mugen no kanōsei he no chōsen-*「イノベーション２５」中間とりまとめ ～未来をつくる、無限の可能性への挑戦～ [Interim report on "Innovation 25": building the future, a challenge towards infinite possibilities], accessed February 3, 2023, https://www8.cao.go.jp/cstp/siryo/haihu64/siryo3-2.pdf.

[56] Seiji Iwata and Ryuichi Kanari, "Japanese robots long gone before Fukushima accident", *The Asahi Shinbun*, May 26, 2011, https://web.archive.org/web/20140903061944/http://ajw.asahi.com/article/0311disaster/fukushima/AJ201105260215.

[57] Timothy Hornyak, "How robots are becoming critical players in nuclear disaster cleanup", *Science*, March 3, 2016, https://www.science.org/content/article/how-robots-are-becoming-critical-players-nuclear-disaster-cleanup.

investments aimed at tackling the issues of aging society and environmental risk, expected to create new knowledge and technology and consequently generate new economies, export and international competitiveness, as well as positive reputation and international soft power. The creation of human resources was another pillar, to the point that when the third Abe administration revamped its policy as "Abenomics 2.0", the new three arrows included the so-called "Womenomics" policy to sustain public childcare and raise women employment, as well as strategies to create new employment opportunities for seniors and retirees[58].

The newly founded "Headquarter for Japan's Economic Revitalization" (日本経済再生本部, *Nihon keizai saisei honbu*), in charge of the macroeconomic policy, also took guidance over robot policies, and released the "New Robot Strategy" (ロボット新戦略, *Robotto shin-senryaku*[59]) in 2015. The report represents a major step in the development of the sociotechnical imaginary about service robots; in it, the government states its intention to trigger a "robot revolution" which will transform Japan in a new roboticized society. To reach this end, however, the definition of robots must be stretched to its limits: in the view of the drafters of the report, robots are undergoing a major transformation, from simple machines capable of doing a limited range of complex tasks to intelligent machines able to autonomously learn new tasks through AI technology, connected to each other through the Internet of Things (IoT) and, most importantly, acting as an ubiquitous interface rather than a tool, similarly to smartphone and computers. Thus, robotics must expand to other fields, such as domotics (home automation), automotive (self-driving cars) and smart infrastructures. In other words, robots are imagined to become the joining link between the virtual space of data and computing and the physical word with which they are expected to interact.

The report goes on pointing out at the already ongoing collaboration in the US and EU between public and private sector to establish new standards and shared practices in response to the ongoing digital transformation and automation of the value chain, through the "Industry 4.0" initiative proposed by Germany. Being at the forefront of this transformation, and thus able to set the standards, is a key to international competitiveness and success, the report argues: only by becoming the main platform for a new technology, it is possible to capitalize on the big data

[58] "*Abenomikusu 'sanbon no ya'*" アベノミクス「3本の矢」[The "3 arrows" of Abenomics], Official Website of the Prime Minister of Japan and His Cabinet, accessed February 3, 2023, https://www.kantei.go.jp/jp/headline/seichosenryaku/sanbonnoya.html.

[59] Nihon keizai saisei honbu 日本経済再生本部, *Robotto shin-senryaku* ロボット新戦略 [New robot strategy], accessed February 3, 2023, https://www.kantei.go.jp/jp/singi/keizaisaisei/pdf/robot_honbun_150210.pdf.

that interface technologies gather, and further expand by offering new high-added value services and products. The underlying fear, again, is that of ending up in a lock-in in obsolete technologies, which the report evokes through the image of the Galapagos cellphones from the early 2000's – a period in which the cellphone industry in Japan developed highly advanced technologies but failed to adequate to international standards and eventually fell behind the US and Chinese giants of the smartphone industry, a phenomenon known as *garapagosu-ka* (ガラパゴス化, "Galapagos effect"). To be at the forefront of the transformation, the report proposes to extend the use of robots as interfaces to the whole society, transforming Japan into an international hub for innovation in robotics and a society where robot use is maximized in every field. To this end, Japanese society must change and become a "barrier-free society for robots". Only when robots will be used in daily life as well as in all sectors of industry will Japan secure the status as a platform for robotic technology. Again, the use of special zones with less regulation and test fields is advocated to enable the testing of robots in real scenarios. Showcasing robot technologies will also raise the interest of international observers and attract potential investors. For the same reason, the report proposes to institute a "Robot Olympics" contextually with the Tokyo Olympics scheduled for 2020.

The ideas advanced in the "New Robot Strategy" ultimately flowed in the 5th Basic Plan for S&T, which advances the proposal to realize "Society 5.0" or "super-smart society" (超スマート社会, *chō-sumāto shakai*)[60]. Society 5.0 is a buzzword echoing the German project of Industry 4.0 and refers to a new mode of society which, according to its proponents, will follow the previous stage of hunting/gathering society, agricultural society, industrial society and information society. Its main features are the collection of big data at a whole-society level through ubiquitous networks of sensors and interfaces, the automation of data analysis through AI and the connection of physical space with cyberspace through what are defined as "cyber-physical systems". In this vision, AI operate as the brain of these cyber-physical systems, robots as their muscles and IoT technologies as their nervous system. The goal of Society 5.0 is to utilize big data to better allocate resources throughout society and produce more added value. In other words, it consists of the application of industrial management to the entire society to minimize wasting and maximize the creation of value. Society 5.0 is, in my opinion, the last

[60] "Society 5.0", CAO (Cabinet Office, Government of Japan), accessed February 3, 2023, https://www8.cao.go.jp/cstp/english/society5_0/index.html.

step in the development of the sociotechnical imaginary of service robots in Japan: first proposed in 2017, it still informs S&T policies and it represents the confluence of the imaginary of robots with that of digitalization, providing a role for robots in the new data-driven economy. While other policies concerning robots are to be found after the 5th Basic Plan, I will end my analysis here, for it is my opinion that, after the introduction of Society 5.0, the imaginary about robots became solidified. In the next section, thus, I will summarize and discuss the main features of these imaginary, which I describe as "Robots for Revitalization", that have emerged through this analysis.

2.2.2 "Robots for Revitalization": discussion

The analysis of policies concerning robots between 2000 and 2017 has revealed the narrative about these technologies, a sociotechnical imaginary born from the negotiation between the necessity of robot industry to open new markets and preserve competitivity and that of governments – informed by the ideal of *kagakugijutsu-sōzō rikkoku* – to find technoscientific and economic solution to the issue of aging society and improve the macroeconomic performance of the country. Over the course of two decades, this narrative has remained strongly consistent although ultimately merged with the larger narrative of Society 5.0. I name this imaginary "Robots for Revitalization": revitalization because in this imaginary, robots are obviously associated to the economic revitalization pursued by Japanese governments, but also to the desire to bring new life to a society that is perceived as old and slumbering. The scope of revitalization goes from securing robotic successors to the aged workforce of traditional industries like agriculture and forestry, to the revitalization of rural areas which robots will provide with services otherwise clustered in the metropolis, to bringing new energies to senior citizens, to making easier for mothers to raise their children. The word revitalization implies an organic metaphor: indeed, in this imaginary, society is often conceptualized as a living organism which is aging, and robots as a life form which must be integrated into society to replace the demographic losses – hence the slogans of "coexistence of human and robots" and "barrier-free society for robots".

Keeping that sociotechnical imaginaries consist of visions of desirable future in which values are attached to technologies, I argue that in the case of service robots in Japan these values can be identified in terms of efficiency/productivity and security. These values descend from the original purposes for which industrial robots were adopted: improving the productivity of factories working faster and longer than human workers, being more cost efficient, and

replacing human workers in dangerous tasks. When robots became envisioned as entering society, these two values had to be modulated on its necessity, overcoming some paradoxes.

In the case of security, the paradox lies in the fact that robots themselves represent a risk factor. In factories, while robots perform tasks which would be dangerous for human, the environment of the factory is projected in a way that keeps them isolated from human workers to prevent robots from harming them, but when introducing robots into daily-life scenarios, the co-presence becomes inevitable. On one hand, service robots are expected to improve society's security and safety, through patrolling robots or care robots that watch over children or non-autonomous elders; on the other, the more a robot interacts with human, the more it becomes dangerous. This paradox has been faced by Japanese institutions through the introduction of safety standards, guidelines and regulation[61]. However, these regulations have been described as being oriented towards limiting the liability of makers and raise the responsibilities of end-users, and as being considered important mostly to facilitate the diffusion of next-generation robots and secure a regulatory platform position for Japan[62]. Since robots are indispensable to society, once makers and institutions have concerted safety standards and guidelines and makers respect them, it will be citizens to be held responsible and called to modify their behavior in order to "coexist with robots". Furthermore, the use of robots for surveillance purposes also raises privacy issues, which have been similarly faced by institutions through regulations and guidelines. However, given the emphasis that the Society 5.0 narrative puts on big data as a source for creating added value, it is to be expected that regulations will be aimed at encouraging the circulation of data rather than protecting the privacy of citizens. In substance, while security is envisioned as one of the desirable outcomes of the introduction of service robots, this security has to be exchanged with a partial reduction of citizen's privacy and an increase in their liability. The issue is also minimized through the insistence of robot makers and engineers on the supposed high acceptance of robots in Japan, on concepts of harmony and coexistence and on the inevitability of the introduction of robots in society.

As for efficiency/productivity value, the sociotechnical imaginary seeks to conjugate economic growth with the wellbeing of citizens, and in some way go as far as equating productivity with wellbeing. Just like industrial robots, service robots are expected to replace human on the workplace in tasks like customer reception, to enhance the productivity of the service sector.

[61] Tomoko Nambu, "Legal regulations and public policies for next-generation robots in Japan", in *AI & Society* 31, no. 4 (2016).
[62] Hironori Matsuzaki and Gesa Lindemann, "The autonomy-safety-paradox of service robotics in Europe and Japan: a comparative analysis", in *AI & Society* 31, no. 4 (2016).

At the same time, they are also expected to replace humans in care activities traditionally outside the scope of economy, like childcare, house chores and eldercare. This is expected to raise the participation of women, helping them as working parents, or seniors, helping them to postpone their retirement. The paradox is that while service robots are expected to free people from care work and let them do productive work and, at the same time, to replace human labor in even more field than industrial robots: more workforce and less jobs would seem incompatible, but this is conveniently resolved by picturing the demographic reduction and shrinkage of the workforce as inevitable. Interestingly, this imaginary contradicts typical expectations, both utopian and dystopian, about robots, which are usually pictured freeing human from having to work, or stealing jobs. Under the vision of "Robots for Revitalization", if the robots enable more free-time, citizens are expected to use it on productive activities, and to move from unskilled to qualified jobs. However, while it may be true that robots will not steal jobs neither free humanity from work entirely, it should be noted that automation has been criticized for leading to deskilling on the workplace in Japan[63].

Furthermore, in this imaginary well-being itself is associated with being productive: and a healthy senior is one that can still perform his job although through robotic augmentations. Through care robots, care itself is pictured as becoming productive: instead of unproductive public expenditure on social security funded by public debt, care robots are expected to provide a better service while generating new added value. However, the proposal of a widespread introduction of care robots, today still expensive, raises the question of who will shoulder the expenses for these objects and what model of care is being proposed: for example, if home assistance provided by care robots is to be paid by citizens, given the high cost of this devices, this will result in an inevitable problem of who can afford this new type of care. In other words, an excessively techno-optimistic view of care robots and service robots might divert the attention from other necessary measures that have to be taken in order to secure the sustainability of social security.

2.2.3 The performance of the sociotechnical imaginary

In order to become a driving force in society, a sociotechnical imaginary need to expand its influence out of the small network of actors proposing it and into the wider sphere of the nation, to produce the desired vision of future in the conscience of citizens. While policies represent an optimal site of enquiry to understand how governments, corporations and experts formulate an

[63] Saori Shibata, "Digitalization or flexibilization? The changing role of technology in the political economy of Japan", *Review of International Political Economy* 29, no. 5 (2022).

imaginary, performative acts show how the imaginary is communicated to ordinary people. By performative acts, here I mean staged events of high symbolic value that enacts theatrical representation of the desired vision of future that the sociotechnical imaginary suggest. As Jasanoff reminds us, "Performances of statehood in modernity are increasingly tied to demonstrations and to public proofs employing scientific and technological instruments […][64]". Thus, public demonstration of the use of robots will be the first object of research in this section. As my analysis of policies already highlighted, Japanese institutions were immediately aware of the necessity of familiarizing citizens with service robots through demonstrations of their application in daily life. This has been pursued mainly in two ways: showcasing robots at specifically designed exhibitions, and testing robots in real-life scenarios through the designation of special zones where specific regulations are in place.

As for exhibitions, world fairs (EXPO) and Olympics are prime examples, due to their highly symbolic value, and their function as international stage for nation branding. As highly staged events, they are perfect to showcase robots: usually held in locations that are designed specifically for the event, they thus provide a blank environment which can be built around the necessity of robots, much like a factory is. Moreover, the staged environment is bound to set limits to the behavior of attendees, which is going to be much more predictable than in real-life scenarios. Robots themselves are going to be constantly monitored by large crew of technicians and other trained personnel, assuring they perform in the desired ways. In other words, in this kind of event it is extremely easy to perform the desired vision of future attainable through robots in spite of the current limitations of the technology. Not surprisingly, this has been a preferred method for Japanese institutions since the first emergence of the sociotechnical imaginary of service robots. The discussion in this section relies on promotional materials such as pamphlets, official websites and videos, as data for the analysis of these events.

As already touched on in the previous section, one of the first occasions in which the "Robots for Revitalization" imaginary was presented to the international public was the EXPO 2005 at Aichi. The theme of the fair was "Nature's Wisdom", and it was one of the first international events to address the global environmental issues, marking a remarkable departure from the positivist narration of past world exposition centered on progress. The EXPO's message condemned the indiscriminate use of technology for the pursuit of economic growth of the previous century, but did not refuse technology entirely:

[64] Jasanoff, "Future Imperfect", p. 10.

> It is […] increasingly imperative that we regain nature's wisdom and that our proud technological achievements incorporate this wisdom. […] We want to free technology from the unthinking pursuit of efficiency and economic rationality and from rigid social systemic constraints-to awaken the wisdom embedded in the technology and to enable technology to once again interact sensitively with life and nature. Technology is not inherently eco-destructive, and at its best it exists in a creatively complementary relationship with nature[65].

This extract from the EXPO's message reproduces once again the *kagakugijutsu sōzō rikkoku* ideal of a responsible science that addresses the global issues and pursues a sustainable growth, abandoning the industrial development model. To realize concretely this ideal, the EXPO was developed so as to be a representation of a possible future eco-sustainable community: the location of the event was built minimizing the environmental impact with recycled material, the surrounding ecosystem was preserved, and the venue was populated with a myriad of (then) futuristic and eco-friendly technologies, including hydrogen-powered buses, one of the first operating magnetic-levitation trains (the "Linimo", short for linear motor car), solar panels, and our next-generation robots. Thanks to a project supervised by NEDO and in collaboration with private corporations, visitors could find on site 6 types of robots performing practical tasks (including cleaning robots, patrol robots, social robots assisting visitors by providing indication, childcare robots and smart wheelchairs), an exhibition of 63 prototypes, and several other performing robots (including a performance by a robotic orchestra provided by Toyota).

To present robots and other technologies as different from the destructive ones from the past, the event pictured them as being in harmony with nature and local culture. As argued by Šabanović:

> […] the Expo's message cautioned that the societal benefit of technology depends on its fit with the natural and social environment. The event represented Japan as a place in which technology is in harmony with cultural values and traditions. The Aichi Expo's fusion of advanced technology, cultural tradition, and future projection exemplifies a broader 'foundational schema' […] in Japan, which legitimizes the development and adoption of emerging technologies through association with traditional practices and cultural continuity[66].

As examples of these assemblages of technology, tradition and pop culture, we find many of the strategies already exemplified in chapter one: in a promotional video realized by the national

[65] "EXPO 2005 Message", The Official Website of EXPO 2005 AICHI JAPAN, accessed February 3, 2023, http://www.expo2005.or.jp/en/whatexpo/concept.html.
[66] Šabanović, "Inventing Japan's robotic culture", p. 345.

television NHK for the Ministry of Foreign Affairs (MOFA), robots are linked to *karakuri ningyō*, portrayed as their progenitors, and the HRP-2 humanoid robot created by AIST is seen performing on stage at the Prototype Robots Exhibition, playing a traditional *taiko* drum and sporting its futuristic look inspired by the anime *Mobile Police Patlabor* (機動警察パトレイバー, *Kidō keisatsu patoreibā*)[67].

Figure 7: HRP-2 at Expo 2005.
© Web Japan, MOFA (Ministry of Foreign Affairs of Japan)

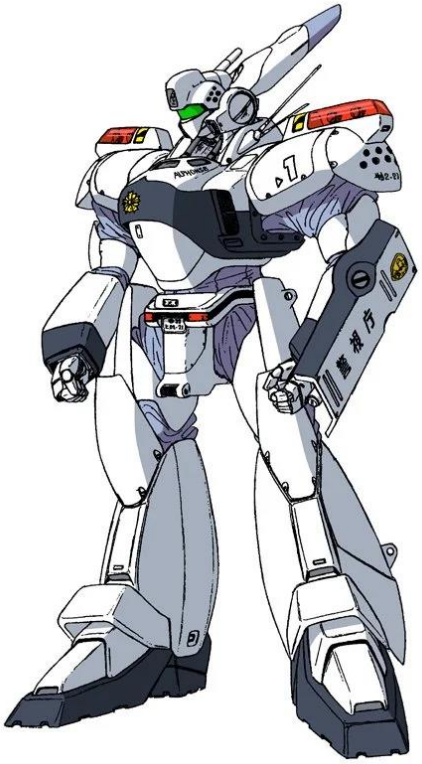

Figure 8: the robot 'Alphonse' from the anime *Patlabor*.
© Shōgakukan

The Aichi Expo was a successful performance of the sociotechnical imaginary about service robots: not only it showcased Japan's advanced robotic technologies to citizens and international visitors, it also served as a field test, experimenting with true interactions between service robots and people for the first time, without incidents. As already touched on, the success of the Expo prompted later administrations, in particular those lead by former PM Abe, to pursue further investments in service robots.

Ten years after EXPO 2005, Abe proposed to held a "Robot Olympics" in concomitance with the Tokyo 2020 Summer Olympics and Paralympics. The Olympics were of great symbolic importance in the eyes of the Abe administration, both as a crowning of the longest mandate in

[67] Japan Video Topics, "JVT 2005.6 – Robot Partners", YouTube video, January 22, 2017, 1:03, https://www.youtube.com/watch?v=74fi9FwS6jU.

postwar Japan, and as a new start, coinciding with the beginning of the new Reiwa Era after the abdication of former Emperor Akihito in 2019. As Abe stated in his New Year speech for 2020:

> Our prospects for the future are now filled with positive dynamism. Now is the time to press forward vigorously with nation-building for a new era. […] Keeping an eye squarely on the future, we will advance major reforms associated with this nation's vision. Beyond that lies constitutional amendment. Here, as we ring in the second year of Reiwa, I have renewed my determination to work towards nation-building for a new era[68].

In other words, Abe expected the Olympics to give new momentum to the political action of the government, which was stagnating after the Abenomics policies failed to deliver concrete results on many fronts and the government was unsuccessful in achieving full majority to purse the long-yearned-after constitutional reform. In fact, the postponement of the Olympics due to the COVID-19 pandemic marked a decisive defeat for Abe, which subsequently resigned in August 2020, allegedly due to health issues. Anyway, the fact that he had envisioned a Robot Olympics lets us understand how much importance he attached to robot policies in the context of his vision of a new era.

Eventually, the Robot Olympics were never held, but robots were present nonetheless at the event in various forms. The Government of Japan, the Tokyo Metropolitan Government, Toyota, Panasonics and scientists from AIST cooperated to realize the "Tokyo 2020 Robot Project", which brought in the event's venues service robots such as support robots to carry personal belongings for disabled attendees (although ultimately the event was held without an audience due to the COVID19 pandemic), support robots to help the staff retrieve javelins and other sport equipment, telepresence robots consisting of real-life-sized screen mounted on wheels that enabled people to attend the event even if not in person[69]. Significantly, even the mascots of the event are robots, and embody one more time the aforementioned assemblage of technology, tradition and pop culture. The mascot of the Olympic, Miraitowa[70] (from the fusion of *mirai* 未来 "future" and *towa* 永遠 "eternirty") and that of the Paralympic, Someity[71] (a wordplay on

[68] "New Year's Reflection by the Prime Minister", Official Website of the Prime Minister of Japan and His Cabinet, accessed February 4, 2023, https://japan.kantei.go.jp/98_abe/statement/202001/_00001.html.
[69] "Tokyo 2020 Robot Project: Dr HIRUKAWA Hirohisa - Showcasing the future of sporting events", IOC (International Olympics Committee), accessed February 4, 2023, https://olympics.com/en/news/tokyo-2020-robot-project-dr-hirukawa-hirohisa-to-showcase-future-of-sporti.
[70] "Tokyo 2020 Olympics Mascot – Photos and History", IOC, accessed February 4, 2023, https://olympics.com/en/olympic-games/tokyo-2020/mascot.
[71] "Meet Someity: the Tokyo 2020 Paralympics Mascot", IPC (International Paralympic Committee), accessed February 4, 2023, https://www.paralympic.org/tokyo-2020/mascot.

the *someiyoshino* 染井吉野 variety of cherry and the English sentence "so mighty"), are designed as anime characters, with their bodies covered in chessboard patterns inspired to traditional kimono motifs. They are robotic in appearance, and described as digital beings gifted with superhuman powers, which live between the physical world and the cyberspace, representing thus a fictional account of the cyber-physical systems envisioned in the Society 5.0 imaginary and, at the same time, a reinterpretation of the Shinto concept of *marebito* (稀

Figure 9: Miraitowa and Someity
© Tokyo 2020

人), "visiting gods" that manifests temporarily in the human world.

Toyota also realized a real robot version of the mascots targeted at kids, equipped with moving limbs and head, facial-recognition system, and display in their eyes capable of reproducing movements and emoji-like expression[72]. In synthesis, the Olympics were once again envisioned as a theatrical stage to perform the desired future vision of a society where robots support human life.

Continuing this tradition of megaevents used as a showcase for Japanese technological prowess, robots will be an important part of the EXPO 2025, to be held in Osaka. The theme of this

[72] "Tokyo 2020 Robot Project: Toyota Motor Corporation - Mascot robots bring smiles to children", IOC, accessed February 4, 2023, https://olympics.com/en/news/tokyo-2020-robot-project-toyota-mascot-robots-bring-smiles-to-children.

edition will be “Designing Future Societies for Our Lives”, establishing once more the event as an international stage for the performance of a desirable future. The following quote from the EXPO 2025 Master plan states explicitly which society the Japanese government is intent on building:

> The challenge of verifying the possibilities of applying new technologies, services, and systems to real society will be tackled at the super-smart Expo venue, which forecasts a future society. In this sense, Expo 2025 Osaka, Kansai, Japan, will offer an opportunity to verify the possibility of achieving Society 5.0[73].

The EXPO venue will be built both to perform the imaginary and to test its possibilities. The venue will be equipped with technologies such as service robots (dubbed as “human friendly”), IoT equipment and ubiquitous connection through AIs. Furthermore, the event is imagined as a new starting point for humanity after the COVID-19 pandemic. The subthemes, “Saving Lives”, “Empowering Lives”, and “Connecting Lives”, insist heavily on the topic of life and vitality, and propose to inject new vital force in a society hit by the pandemic through

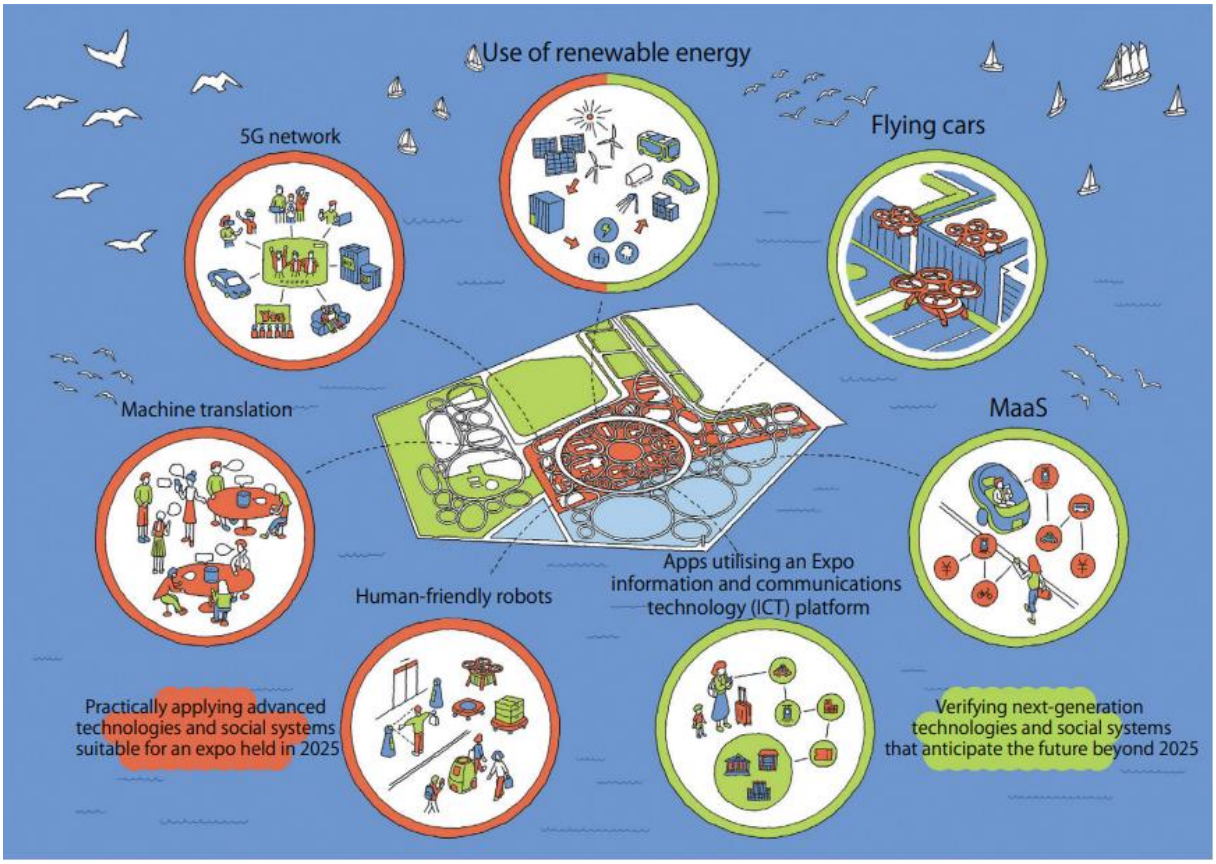

Figure 10: Vision of the Expo site as a model for Society 5.0
Source: Japan Association for the 2025 World Exposition

[73] Japan Association for the 2025 World Exposition, *Expo 2025 Osaka, Kansai, Japan Master Plan*, accessed February 4, 2022, https://www.expo2025.or.jp/wp/wp-content/themes/expo2025orjp_2022/assets/pdf/masterplan/expo2025_masterplan_en.pdf, p. 9.

technology. Furthermore, one of the thematic projects of the EXPO, named "Amplification of lives", is directed by Hiroshi Ishiguro, a roboticist famous for his hyper-realistic humanoid robots. The projects "aims to expand the functions and capabilities of humans and other organisms and explore wider possibilities for lives with novel science and technology"[74]. While the event is still in the design phase, it is already apparent that it will be completely aligned with the *kagakugijutsu sōzō rikkokuI* ideals, and with the sociotechnical imaginary of "Robots for Revitalization" and its iteration of Society 5.0, picturing robots (and other technologies) as life forms to be integrated in human society and expected to revitalize it.

Concluding my analysis of megaevents as sites of performance for the sociotechnical imaginary, I consider worth pointing out that the significance and symbolic values of such events lies not only in the international coverage that they enjoy, but also in the historic value that they have in the eyes of the Japanese public, as they are ideally connected to their antecedents, the 1964 Tokyo Olympics and the 1970 Osaka EXPO. These two events marked the end of the postwar struggle for economic catch-up and the beginning of the age of economic prosperity and of "Japan as no. 1". To give an example of how the events are symbolically linked, one can point out at the genealogy of high-tech trains in Japan: the first high-speed railway of the bullet train Shinkansen was inaugurated just in time for the '64 Olympics, and the first operating maglev train LINIMO for the EXPO 2005. The symbolic linkage between these events further sustains the narration of a "revitalization" of Japan and its economy through the nostalgia for a golden age of prosperity and international success.

Alongside megaevents, a more sober but no less important form or performance of the sociotechnical imaginary is that of special zones where specific legislation is put into place to test robots or other technologies. Known in Japanese as *tokku* (特区, "special district"), these administrative areas have been used as a main tool for Japanese institutions to test possible structural reforms in many fields, not just for technology. In the case of robots, there have been many *tokku* utilized as test fields for real life operations, each dedicated to a particular type of robot, such as the *mobiriti robotto jikken tokku* (モビリティロボット実験特区, "special zone for mobility robots testing") to test self-driving mobility devices, in Tsukuba city, the *kokka senryaku tokku* (国家戦略特区, "special zone for national strategies") for testing care robots, in Kitakyūshū city, and the *robotto sangyō tokku* (ロボット産業特区, "special zone for robot

[74] *Ibidem*, p. 30.

industry") in Sagami, dedicated to "life-support robots" (including care robots and house-chore robots). As mentioned before, these areas have two different functions: first, to familiarize citizens with robots, and secondly, to bypass existing regulations which would make difficult for robot makers to test their machines in real life scenarios. In these *tokku*, the usual regulations can be ignored, provided that the local police give its permission[75].

Of particular interest for this analysis is the *tokku* of Sagawa. The project, also known as "Robot Town Sagami", alongside tests and demonstrations, has launched a promotional campaign that utilizes the most iconic fictional robot, Atom, as a testimonial of the future vision of the city. The promotional website describes the *tokku* as a place where robots that supports daily life, create a safe society, and help realize people's dreams are born. Real robots utilized in the *tokku* are described as created aiming at realizing the seven powers of Atom: 10000 horsepower strength (manipulators and exoskeletons), eyes equipped with searchlights and camera (research robots for disaster sites), 1000x enhanced hearing (security robots), artificial vocal cords programmed to reproduce multiple languages (social robots and machine translation), electronic brain (AI powered self-driving vehicles), the atomic heart which can distinguish good and evil (care robots), and jet engines (delivery drones)[76].

Atom also appears as a character in a promotional anime short created for the Robot Town Sagami initiative in collaboration with Tezuka Production, titled "Robot Town Sagami 2028" [77]. In the short, a typical young salaryman working late, named Takao, learns from his wife that they are going to become parents. Rushing home to celebrate, he stops to buy a plush toy of Atom. Unfortunately, as he exits the toy store, he gets hit by a car who lost control. Takao wakes up only to find himself in an out-of-body experience, watching helplessly his bedridden body as the physician tells his wife Yumi that even if they will manage to save his life, he will be paralyzed. Takao is about to give in to despair for he will not be able to protect his wife and see his child grow up, but Atom materializes in front of him and asks if he wants to see the future. The incorporeal Takao is then absorbed by a vortex and sent to what the credits inform us being "Robot Town Sagami 2028". Takao opens his eyes and sees a maglev Shinkansen dashing at full speed on a futuristic rail – the new maglev shinkansen is indeed expected to open in 2027 and the line will connect Tokyo to Nagoya, passing by Sagami. Takao and the viewers

[75] Tomoko Nambu, "Legal regulations".

[76] "*Sagami de umareru nanatsu no chikara"* さがみで生まれる七つの力 [The seven powers born in Sagami], Robot Town Sagami, accessed February 4, 2023, https://sagamirobot.pref.kanagawa.jp/7powers/.

[77] Tezuka Production, "Robot Town Sagami 2028", YouTube, April 13, 2016, https://www.youtube.com/watch?v=zKN1sjbz590.

are then presented with several scenarios in which robots help people, such as people sweeping past him on mobility robots, foreigners asking directions at social robots installed in public squares, and one blind person being guided by care-robots. Just as Takao realizes that he is a ghost (he cannot be seen or touched by other people) and assumes he must be dead, he sees his wife Yumi and a girl named Hina: his daughter. Hina carelessly crosses the street and she is almost hit by a car, just like her father, but this time the car is an automated-driving vehicle that stops just in time to assure that the girl is unharmed. Takao then follows his family home, where we are presented with another series of scenes where robots and digital technologies helps them in their daily life, mainly centered around Robita, a smart and sassy social robot which acts as the main interface for their automated house. Robita is depicted as a member of the family, calling Yumi "mom" and joking with Hina. He also monitors their physical parameters and health, reminds them of their tasks and puts them in contact with the grandparents through a videocall. Grandpa is seen being assisted through telemedicine, while grandma sends them a package of vegetables (an expensive and rare good in the metropolis) which is delivered by drones. The ghost-like Takao is relieved to know that his family, in this future, is protected by robots and lives happily, although he regrets not being able to be there with them; he also appears jealous and worried when he sees a pair of man shoes and realizes Yumi must have remarried. Just when he is immersed in such thoughts, a person comes back home from work. In a plot twist, it is revealed that the person is the future Takao himself, which, knowing the past Takao is there, tells him he will be alright: he is using a robotic exoskeleton which allows him to move despite the accident. The short anime returns in the present and ends with Atom, which delivered the vision to the comatose Takao, flying away in the sky and telling the viewers that such a future in which life is shining is coming thanks to the Robot Town Sagami project.

"Robot Town Sagami 2028" is a perfect fictional performance of the "Robots for Revitalization" imaginary. The representation of robots is a blend of realism and science-fiction, communicating to the viewers what has already been achieved by robotics and at the same time magnifying how much more can be done. The sentimental narration fits perfectly in the imaginary: robots are seen as coexisting peacefully with humans like family members, perfectly integrated into society, protecting people and helping them in their daily lives. The plot twist in which we learn that Takao is still alive is literally a "revitalization": the protagonist is reborn through the use of robotic technology, and this reminds us that robots are not going to replace humans, but instead bringing them new life force – a topic on which several policies analyzed in the previous sections insist repeatedly.

This sort of use of SF to promote the sociotechnical imaginary about robots is not new: it is inscribed in a bigger pattern of Japanese institution utilizing anime and manga to explain policies and complicated subjects to the public. Wagner highlights the continuous efforts of governmental institution to promote the diffusion of care robots through science-fictional account of desired futures:

> […] the positive image of robots and their continuous narration in form of manga, anime and (governmental) science fiction stories is a successful "cultural construction". It enables engineers and the Japanese government to propose a future "robotic lifestyle" with special emphasis on the development of robots for the elderly[78].

Governmental institutions and robot makers do not only utilize already-existent pieces of fiction and popular culture to promote a positive image of robots, as in the case of "Atom and Robot Town Sagami 2028", they also produce their own. Indeed, science fictional accounts of the desired future are already found in the policies I have analyzed: the *Jisedai-robotto bijon kondankai* report (2005) contained three scenarios of future life with robots in 2025, and the Inobeshon 25 policy of the first Abe administration (2007) an imagined day in the life of the Inobe family together with their life-assistance robots, a fictional family that served as sponsor and mascot for the policy, that received even a manga adaptation. The structure of this is stories is almost identical to the one found in "Robot Town Sagami 2028", except for the fantastic expedient of using out-of-body experience and time travel as narrative devices. In all of them we find a "slice of life" style of narration which shows robots becoming a fundamental part of the Japanese household of the future. Critical analysis of this pieces of governmental science fiction can be found in Wagner and Robertson's works[79], which have highlighted a nationalistic and patriarchal stance:

> Analyzed from a gender studies point of view, the Inobe-Manga clearly promotes the traditional family role of a mother as a housewife, who manages her household and family (with the assistance of robot technology), though in the manga she also juggles a part-time telework-job. Furthermore the report and manga suggest a very nationalistic technological empowerment vision towards China. In the book the rivalling country is described as looking up to Japan for its progressive bio- and robot technology[80].

[78] Cosima Wagner, "'Silver Robots' and 'Robotic Nurses'? Japans Robot Culture and Elderly Care", in *Demographic Change in Japan and the EU: Comparative Perspectives*, ed. Annette Schad-Seifert and Shingo Shimada (Berlin: Düsseldorf University Press, 2010), p. 147.
[79] Jennifer Robertson, *Robo Sapiens Japanicus*, pp. 50-62.
[80] Cosima Wagner, "Silver robots", p. 142.

“Robot Town Sagami 2028” might be an upgraded version of these governmental SF stories, powered by the technical quality of the animating studio and with a subtler narrative; however, a critical analysis reveals the persistence of a stereotyped vision of the Japanese family and nation. Takao is the perfect representation of the high-income salaryman, seen working long hours in the night in the first scenes, and coming back late in the last ones. Takao’s family is a typical nuclear family with a single male breadwinner (a type of family which, in fact, is vanishing), whose existence is made possible only thanks to the exoskeleton that let’s the father be a productive member of society. Moreover, since viewers follow Takao and are encouraged to take his point of view, they are likely to identify with him even in his resentment when he discovers that Yumi has remarried, implying that a widow should not remarry so easily. The population of the future Sagami is ethnically homogeneous and the only foreigners seen are white Caucasian tourists, who interacts with robots in place of human beings – Japanese people are often depicted as struggling with English and other foreign languages, and machine translation is envisioned as a solution which will enable communication with the rest of the world. In conclusion, even if the “Robots for Revitalization” imaginary claims that robots will enable a diversity of lifestyles, it is implied that this diversity is limited to housewives maintaining part-time jobs and disabled or ill persons retaining some degree of autonomy supported by robots.

In this section I analyzed performances of the sociotechnical imaginary through megaevents, demonstrations and even fiction. These performances help the critical observers realize the limitations of the imaginary, which can be performed only in highly staged scenarios in reality, and that is limited by the stereotypical assumptions of its proposers in fiction. These analysis highlights the normative aspects of the desired vision of the future attainable through robots, a vision which is mainly targeted at a specific demographic (senior citizens, traditional families) which may not be a realistic representation of Japanese society.

To conclude this section is worth noting that these are just some ways in which the imaginary is performed. Alongside megaevents, demonstrations and SF, many other situations are sites for analysis of this performance: just to quote some, institutional ceremonies involving robots (some robots like Asimo have met foreign head of states, others have been conferred citizenship), and robots showcased at museums and other public spaces. It is also important to keep in mind that this imaginary is not necessarily accepted by the whole society: negotiation and frictions may happen, and even opposing imaginary could emerge. The next chapter will present some examples of how the imaginary is contested, specifically in relation to care robots.

Chapter 3

In the previous chapter, I have described the dominant sociotechnical imaginary about service robot in Japan, which I named "Robots for Revitalization", a name which evokes the fundamental values at the base of the vision of future society that institutions and robot-makers are promoting. The revitalization brought by robots, in this imaginary, invests the economic and social spheres alike, seeking to reconcile economic growth with sustainability and wellbeing. When tackling social issues, robots are expected to revitalize society on the macroscopic level, addressing, for example, the sustainability of the NHS through care robots or the revitalization of rural areas through delivery drones; but they also act on the microscopic level of the individual, literally revitalizing physical bodies. Indeed, as the analysis of the performances and narrations of the imaginary revealed, when speaking to domestic audience in local contexts such as the *tokku*, and not to the international public of megaevents, the main targets are: parents, which are reached through values which promises safety and health for their children; the elders and the disabled, which connects to the imaginary through vision of preservation and empowerment of their bodies and lives. For this reason, care robots, socially assistive robots and life-support robots are the service robots that represents the most direct contact point between citizens and the imaginary proposed by institutions and makers, and at the same time, those where these actors have placed more expectations.

Reminding that sociotechnical imaginaries necessitates a substratum of shared values and experiences to subsist, which emerges through negotiations and even conflicts, my hypothesis is that the aforementioned categories of robots should be those that engender the most visible frictions. Care robots in particular represent an interesting case of study, due to the ethical questions that they rise. Child care and eldercare, in particular, are activities traditionally entrusted to families, that requires emotional skills and both social and physical interactions, and thus less likely to rely on technology.

Starting from this assumption, this chapter focuses on the introduction of care robots in Japan to give a short analysis of how the sociotechnical imaginary is negotiated and contrasted when interacting with different social actors from those who originated it – elders, patients, caregivers. A first section analyzes previous literature concerning these robots. Two more sections present two case studies: one real robot and a fictional one, relating them to the sociotechnical imaginary.

3.1 Care robots as a site of conflicts and negotiations

Given how relevant the issue of super-aging society is in the country's public debate and in the agenda of every Japanese government, it is no surprise that care robots have been a fundamental part of the vision of Japanese institution on how the robot industry should develop to realize a better society since the first R&D consortia sponsored by MITI first and METI later. Already in the '90s, MITI run an R&D consortium on the project 'Mobile meal delivery robot for aged and disabled people' (1995–1999). While this project was finalized to a very specific purpose, later projects, in this field as in others, became increasingly comprehensive[81]. METI launched two comprehensive projects on care robots coordinated by NEDO: a "Project for the development of basic technologies for the realization of human-support robots" (2005-2007), which focused on three macro-areas of robots for rehabilitation, for mobility support of patients and for support of caregivers; and a "Project for the realization of life-support robots" (2009-2013), which main aim was to develop safety devices for robots that would have ensured their conformity to the newly created safety standards.

At the beginning of the '10s the process development of care robots saw a greater degree of coordination between different institutional actors in addition to METI, in particular the Ministry of Health, Labour and Welfare of Japan (厚生労働省 *Kōsei-rōdō-sho*, MHLW). The increasing involvement of MHLW in the government's robot strategy seems to have brought more attention to the expectations of patients, caregivers and nursing facilities, over those of institutions and robot makers. A 2012 report commissioned by MHLW to the Association for Technical Aids (テクノエイド協会 *Tekunoeido kyōkai*, ATA) warned of a facture between the expectations for care robots in the future and a widespread negative perception of their present state, with existing robots considered too much expensive and too little of practical use[82].

Institutions started recognizing the existence of a mismatch between the needs of patients and the technologies offered by robot makers, and so the development of care robots underwent several changes under the new robot strategy of the second Abe administration. In 2013 METI and MHLW established priority areas for the development of equipment based on the needs of

[81] Lechevalier et al., "The effect of participation in government consortia".

[82] MHLW, *Fukushi-yōgu – kaigo robotto jitsuyōka shien jigyō: jigyō hōkokusho* 福祉用具・介護ロボット実用化支援事業: 事業報告書 [Project to support the realization of care robots – welfare equipment: project report], accessed February 8, 2023, https://www.techno-aids.or.jp/research/robo2012.05.28.pdf, p. 31.

patients. Currently, 12 areas are prioritized: transfer aids (wearable and non-wearable); mobility supports (outdoor, indoor, and wearable); toileting aids (excretion support, excretion prediction, mobility support); monitoring (in facilities and at home); communication; bathing support. The development of new robotic technologies in these fields switched from the consortia model to a decentralized model in which firms apply for government fundings – now supplied by METI-controlled Japan Agency for Medical Research and Development (日本医療研究開発機構 *Nihon iryō kenkyūkaihatsu kikō*, AMED) – to do R&D in one of the aforementioned fields. In parallel, MHLW supplies nursing facilities, through the various local governments, with fundings to acquire and utilize such equipment. Intermediary bodies have been established to overcome the mismatch between needs and technologies, providing makers with insights on what needs to address when developing technologies, and nursing facilities with the necessary information and knowledge about existing equipment.

This reorganization of the R&D and diffusion confirms the existence of views held by other social actors involved with care robots (patients and caregivers) that are conflicting with the sociotechnical imaginary proposed by institutions, and the consequent necessity of negotiations. Traces of these conflicting views can be found in previous researches, that have addressed from different angles.

Nobu Ishiguro has investigated the resistance to the diffusion of care robots from the point of view of caregivers, patients and their families, highlighting the existence of a contrasting imaginary, which contrasts "cold" robot care to "warm" human care.

> A contrast between cold care by technology and warm care by human hands might create frictions in care work and care worker resistance to technology. The cold image of care robots reflects, among other things, the government's pursuit of cost containment and care robot industry promotion. Warm care by human hands for older people is a strong value embedded in Japanese care work culture; therefore, the introduction of care robots to alleviate the care work burden or to make older people more independent might enhance the cold perception of technology[83].

As already mentioned, sharing values and practices forms the backbone of any imaginary. Ishiguro points out at the values of familism and collectivism that inform the practice of care in Japan, which are radically opposed to the managerial view of care proposed by the "Robots

[83] Nobu Ishiguro, "Care robots in Japanese elderly care: cultural values in focus", in *The Routledge handbook to social care work around the world*, ed. Karen Christensen and Doria Pilling (New York: Routledge, 2018), p. 260.

for Revitalization" imaginary advocating more individual independence and rationalization of time and resources in care work. However, Ishiguro also recognizes that such view of care is not necessarily fixed and immutable, and that both caregivers and patients might change view if they experience the technologies first hand. Caregivers might assume that elders would not be comfortable to be assisted by care robots due to paternalistic attitude towards elders, but might change view if they see their patients appreciating the robots. The desire to not bother others, which is another Japanese cultural value according to Ishiguro, might be another driving factor for patients to consider the adoption of care robots as a way to not bother their caregivers. Furthermore, the fact that most care robots need to be operated under the supervision of a caregiver might disrupt the view that opposes cold robot care to warm human care, as the interaction between machine and human is still mediated by human hands. This expectation is shared by institutions, as my analysis of policies has revealed the insistence on values such as coexistence between humans and robots and robots not replacing humans but enhancing their lives.

As Ishiguro, James Wright has chosen as a case study the transfer-aid (or lift-aid) robots[84]. This is not casual, as lifting the elderly patients is the task that poses the highest burden on caregivers in terms of physical stress. One of the objectives stated in the new robot strategy under the Abe administration was, indeed, using care robots to drastically reduce the morbidity of back-pain among caregivers, a condition mostly caused by lifting. However, Wright argues that the act of lifting is part of the physical interactions between patients and caregivers in nursing homes, an interaction which is fundamental to the establishment of human connections, and consequently of the good quality of care. In Wright's study, caregivers were more hostile to the introduction of lift aids than, somehow paradoxically, that of social and communication robots: the replacement of physical touch by robots was considered to have a greater negative impact on relationship-building than introducing a robot which is built for that precise purpose. Interestingly, Wright points out how caregivers appropriated of the same managerial view of care advocated by institutions in the sociotechnical imaginary to justify their refusal of lifting aids (despite some patients having accepted them as comfortable), seeing them as reducing the burden but increasing the efforts and time needed to lift patients.

[84] James Wright, "Tactile care, mechanical Hugs: Japanese caregivers and robotic lifting devices", *Asian Anthropology* 17, no. 1 (2018).

Finally, a study by Hsu and others highlighted the existence of contrasting view among care robot developers[85]. While most of them maintained a paternalistic attitude towards the elderly (rarely consulting them to understand their real needs in the development of robots), shared the institutions' dire view of super-aging society and saw the introduction of robots as inevitable, at least some of the developers among those interviewed by the researchers expressed doubts about the real usefulness of their work or of the industry in general, and lamented not being able to involve the end-users in the development process.

While these studies confirmed the existence of ongoing conflicts and negotiations in nursing institutions, it is difficult to evaluate to what extent the institutions' commitment to the promotion of care robots is producing the expected results, as perhaps care robots are still in an early stage of diffusion. A comparative study of public funded projects by Wright finds that, given similar fundings and development programs, the Japanese industry has produced more commercialized robots than the European one, although their diffusion is still limited except for a few models, suggesting that the top-down approach to R&D promoted by METI bore some fruits[86]. A quantitative analysis by Eggleston and others suggests that the adoption of care robots reduces turn-over and difficulty in retaining employees in nursing facilities, while also requiring more staff in the form of part-time employees and reducing the income of regular employees[87]. While some degree of rationalization and a reduction in burden placed on caregivers is obtained, satisfying the objectives of government's policies, it is unlikely that robots will provide a solution to the shortage of caregivers. Similarly, Wright argues that the adoption of care robots in nursing facilities is not going to replace workers, but rather "displacing" them, leading to a reorganization of the relationship between caregivers, patients, and management in the facilities, towards a mode of care which will require less emotional and practical skills, opening to the employment of foreign unqualified labour[88].

3.2 Fictional care robots and conflicting imaginaries: *Rōjin Z*

As mentioned in chapter one, SF often precedes real technology and shapes our imaginary about technologies in terms of hope and fears. In chapter two I have described pieces of SF produced

[85] Eric L. Hsu et al., "The development of aged care robots in Japan as a varied process", *Technology in Society* 63, article 101366 (2020).
[86] James Wright, "Comparing public funding approaches to the development and commercialization of care robots in the European Union and Japan", *Innovation: the European Journal of Social Science Research* (2021), https://doi.org/10.1080/13511610.2021.1909460.
[87] Karen Eggleston et al., "Robots and Labor in the Service Sector: Evidence from Nursing Homes", *NBER Working Paper* no. 28322 (2021), https://www.nber.org/papers/w28322.
[88] James Wright, "Robots vs migrants? Reconfiguring the future of Japanese institutional eldercare", *Critical Asian Studies* 51, no. 3 (2019).

by institutional actors to promote and advance their vision of a future society attainable with robots. Not surprisingly, then, the conflicting imaginary evoked by care robots has been described in SF even before the diffusion of real care robots. One striking example is represented by the animation film *Rōjin Z* (老人 Z, lit. "Old man Z")[89], directed by Kitakubo Hiroyuki and written by the influential *mangaka* and director Ōtomo Katsuhiro. The movie was released in 1991, just two years after the issue of aging society and low birthrates was brought to the public attention by the so-called "1.57 Shock" of 1989 – an expression used to describe the lowest fertility rate recorded in the country's history since the 1966 *hinoeuma* (丙午, "fire horse") year, which according to superstitions was an unlucky year to give birth. *Rōjin Z* anticipates the institutions' vision of a future eldercare revolutionized by robotic technologies only to subvert it, contrasting it sharply with common fears of a dehumanizing and uncontrollable technology, and ironically placing its destructive power in the hands of the care recipient themselves, the elderly.

3.2.1 Synopsys

The movie, set in the 21st century, in a realistic near-future Tokyo, opens with a bedridden elderly man, Takazawa Kijurō, calling for the help of Haruko, a young woman who is volunteering as a caregiver while studying to become nurse. The old man, perhaps affected by dementia, is living alone in an old apartment despite his impairments, and relies on the voluntary nurse to take care of his basic needs like cleaning and feeding. He can only contact her through a pendant-like alarm – though he is supposed to use it only for emergencies. Aside from the nurse, his only company is that of a cat, the TV screen, and the photograph of his late-wife, whose name, Haru, strongly resemble that of his nurse.

Meanwhile, a reunion is ongoing at the MHLW concerning the problem of eldercare. With a language strikingly realistic that closely resembles that of policies I analyzed in chapter 2, the functionaries of the ministries lament the chronic crisis that is afflicting the eldercare system due to the shortage of caregivers and increasing number of elderly people. Terada Takashi, one of the bureaucrats of the Ministry, proudly presents his new project, a sophisticated machine which will solve the problem and bring a brighter future for the elderly, their families and their caregivers. Takazawa is chosen as a test subject, with the approval of his family, and Terada

[89] Kitakubo Hiroyuki 北久保弘之 dir., *Rōjin Z* 老人 Z [Old man Z] (Tokyo: Tokyo Theaters Co. Inc., Kadokawa Shoten Publishing Co. Ltd., Movic Co. Ltd., Tv Asahi, Aniplex Inc., 1991).

picks him up from his home in front of a dispirited Haruko and in spite of the muffled complaints of the old man.

At her university, Haruko learns that the new machine of the MHLW will be showcased at a press conference and rushes there. At the conference, Terada shows his machine: the Z-001 unit is a robotic bed that encases the patient's body and provides fully automated nursing care. Specifically, it can perform bathing, cleaning, feeding, excretion processing, and real-time health checkups while the patient is still in bed. It also has entertainment features such as a television and videogames, and can perform a training routine simulating walking or canoeing while lying down. The device can also be connected to a network and used for video chatting with four friends at the same time, or create a simulated conversation partner, providing a way to spend one's spare time. The onboard computer uses a "6th generation computer" with self-learning artificial intelligence, it is equipped with safety systems capable of resisting an earthquake, and is powered by a built-in micro nuclear reactor. The press watches enthusiastically even as the old man Takazawa is visibly distressed by the operation being performed automatically by the machine without him being able to control it. Only when the nuclear reactor is revealed, there is a concerned voice among journalists, immediately reassured when Terada says that safety measures have been implemented to prevent radiation leakage and incidents. Concerned for the wellbeing of Takazawa, Haruko steps up and interrupts the conference, arguing that even such a sophisticated machine cannot possibly provide the assisted

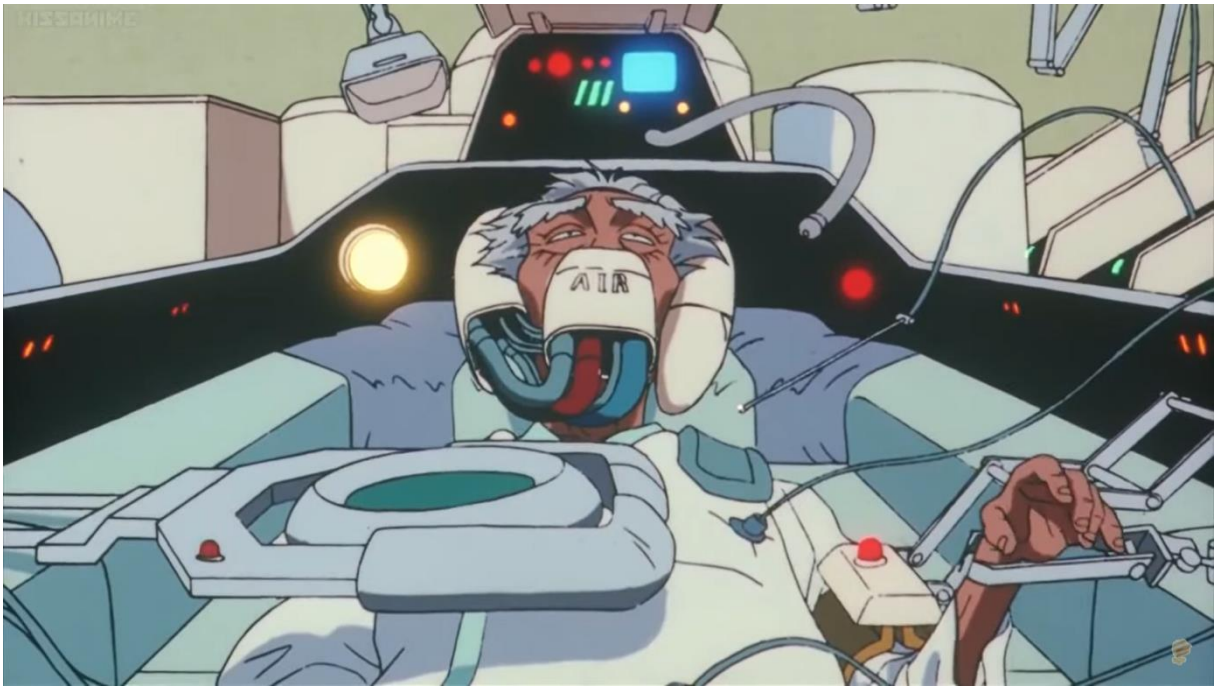

Figure 11: Takazawa in the Z-001 unit

with empathy, human connection and love, but she is silenced by Terada who replies that the love of family cannot be replaced, but the MHLW built the Z-001 unit precisely out of love for the elderly and their families, out of the desire to make their life better.

The conference ends and Takazawa is left in the robotic bed in a facility of the Ministry closed to the public. Back at the university, Haruko finds out that someone has been trying to contact her via her personal computer: soon, all the faculty's computers start displaying her name repeated countless time, together with a call for help. Haruko soon realizes that the one insistingly calling for her help must be Takazawa, just like in the first scene of the movie. Together with her colleagues, Haruko sneaks in the facility, only to be discovered by Terada, who realizes that something is wrong with the Z-001 computer. While Hasegawa, an engineer from Nishibashi Trading Company which has created the care robot, tries to disable the computer, Takazawa starts speaking through the bed's speaker and begs Haruko to go back home with him. The girl tries to separate the old man from the bed, but Terada warns her that it is impossible without killing him. Just as escape seems impossible, the bed starts moving accordingly to Takazawa's desires and dashes out of the hospital towards his old house.

The group's escape ends when thy are reached by the police and the men of the MHLW and Hasegawa manages to stop the Z-001. Back at the Ministry, the Terada and his superior start questioning the real nature of the robotic bed, but their complaints are silenced when Hasegawa makes a phone call to some unknown powerful politician. Meanwhile, Haruko seeks the assistance of a trio of elderly patients at her university's hospital, who she discovers being talented hackers. The trio manage to hack into the 6th generation computer of the Z-001 unit and upload data from Takazawa's late wife Haru to simulate her voice and communicate with the old man, learning that he is in pain and wants to be saved. In the process, they also discover that the Z-001 is powered by biochips, a technology available only to the U.S. military. Eventually, the Z-001 simulates the personality of Haru and develops self-consciousness. The bed starts mutating, incorporating other machinery, and rushes out of the hospital towards Kamakura, to fulfill Takazawa's deepest desire of seeing once again the beaches where he used to spend the summer with his wife, leaving a trail of destruction behind it. Haruko, the bureaucrats of the Ministry of Health, Labor and Welfare, the police and military, and the men of Nishibashi Trading Company chase after it. During the chase, it is revealed that the Z-001 is actually a military robot that Hasegawa disguised as a care robot to field-test it. The second half of the film consists almost entirely of a long chase scene. After a fierce battle with a military-

grade robot from Nishibashi, Z-001 arrives at the seaside in Kamakura and finally stops, having fulfilled Takazawa's desire.

3.2.2 Analysis

The representation of technology offered by this film is ambiguous and nuanced: it would be a mistake to call it a dystopian representation that irrevocably condemns the use of care robots as inhumane and potentially dangerous. Instead, the Z-001 unit has both destructive sides, as it sows panic on the streets of Tokyo by destroying buildings, and a caring nature, as it cares not only for Takazawa but also for Haruko and Terada when they are in danger of being injured during the final chase. The same can be said of many of the characters: with the exception of Hasegawa, the true "villain" of the film, most of them are basically positive characters, although in pursuing their own ends they often prove unscrupulous or unwise. For example, Terada and the other ministry bureaucrats, although they are obsessed with the success of the MHLW project and indifferent to old Takazawa's wishes, are genuinely interested in solving the problem of caring for the elderly-though perhaps for professional rather than human reasons. Moreover, when they discover the true military nature of the Z-001 be project they are outraged. At the same time, Takazawa, although undeniably a victim of events, appears slightly selfish and spoiled at times.

In my view, the vision of technology proposed by the film is rooted in the same cultural background that informs the discourse on robots in Japan described in chapter one. This can be seen from two elements. The first of these is that the Z-001's danger comes from an "alien," foreign element, the biochip produced by the U.S. military. The old Japanese hackers, on the other hand, use the technology for good, to uncover the financial crimes of large corporations and expose them to the public. It should be noted also that the movie playfully parodies the dystopian view of technology found in American SF: when Haruko first meets the trio of old hackers, they are hacking the servers of "Tyrrel Corporation" – a reference to the company building androids in Ridley Scott's cyberpunk movie "Blade Runner" – and the name "Haru" itself is a pun on HAL 9000, the supercomputer which turns into the villain of Stanley Kubrik's "2001: a Space Odissey" after achieving sentience. This type of narrative has a long tradition, dating as far back as the Meiji period, when for Japan, mastering Western technology was an existential matter, and then reinforced when the country decided to embrace atomic power in the postwar period despite the bombing suffered by the Americans: technology in the hands of foreign powers is portrayed as violent and dangerous, but once assimilated by Japan it can become a tool for growth and progress.

The process of assimilation, in the case of *Rōjin Z*, occurs through a form of techno-animism, which is the second element that brings us back to the discussion examined in the first chapter. In fact, the Z-001 unit, in order to transform its military nature into a loving nature, must literally assimilate the "spirit" of a deceased one, that of Haru. The "indigenization" of the Z-001 becomes even more evident when it begins to assimilate elements of the urban landscape, in the end absorbing even the Kamakura *daibutsu*, the giant statue of Buddha. The film, therefore, relies on the belief technological and inanimate objects can still contain a soul, even if the final scene in which all characters bow in front of the robot-turned-buddha ironizes on the acritical adoration of technology.

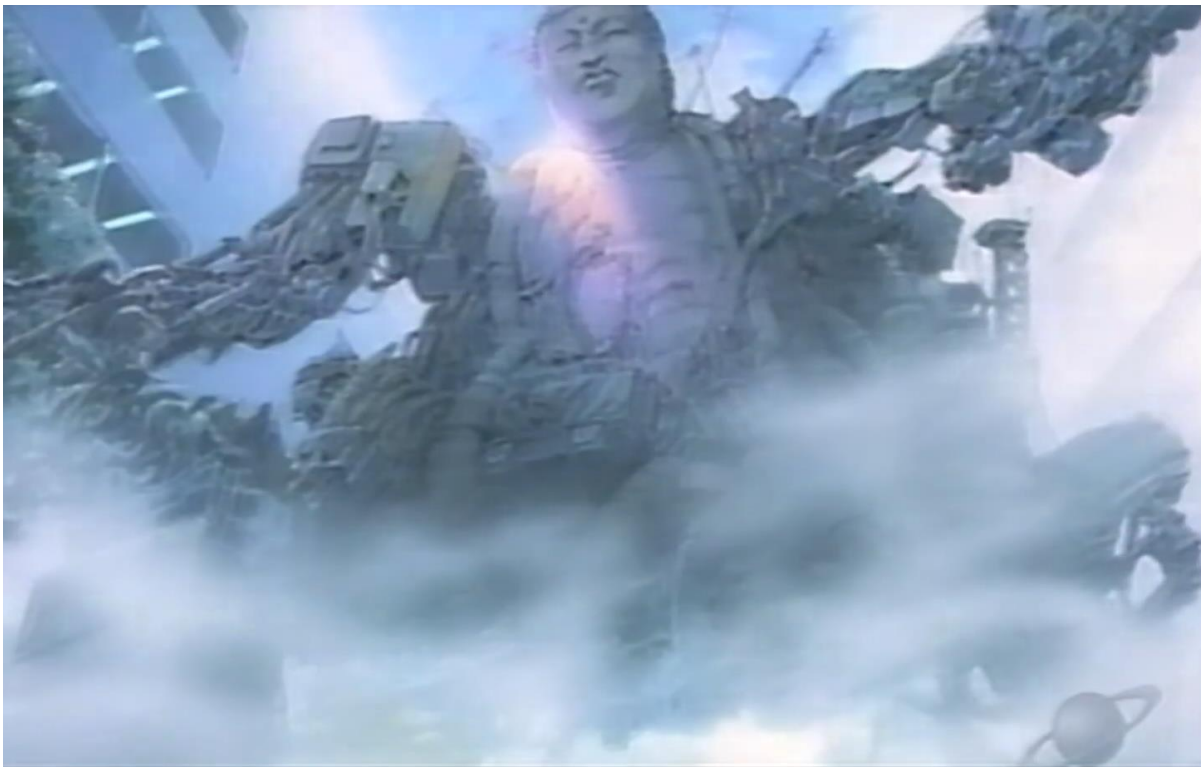

Figure 12: The Z-001 after absorbing K
© TOKYO THEATERS / KADOKAWA / MOVIC / TV Asahi / Aniplex

How does the representation of care robots in *Rōjin Z* relates with the sociotechnical imaginary I described in chapter 2? The movie anticipates the the Japanese institutions' techno-optimistic and managerial way of tackling social issues such as aging society. It warns that, although well-intentioned, such an approach might overlook the intentions and desires of the persons directly concerned – the elderly. By portraying technologically savvy old characters such as the hackers, it subverts the role envisioned in the institutional project: the elderly, which should be the recipient of technological care, take control over it in the form of the old hackers and of Takazawa "piloting" the Z-001. Furthermore, the movie vividly depicts the aforementioned contrast between cold technological care and warm human care, embodied by the character of

Haruko and her intervention at the Z-001 presentation conference. Haruko declare that a machine cannot provide love, and Terada agrees. But again, the movie subverts our expectation: ultimately, the Z-001 is able to love its assisted, but the effects of this love are quite disruptive. In my opinion, the biggest question raised by the movie is the following: even if technology could address the needs of the elderly, are those needs the same that the rest of society expects from them, and is technology the best way to address them?

Furthermore, the movie raises another point of contrast beside that of cold VS warm care: the widespread aversion of Japanese people to military use of technology. Although in this thesis the subject has been touched upon only marginally, it is a much lively topic in the Japanese public debate over the direction of R&D in the country. A telling example is given by one of the Japanese leading care-robot-making companies, Cyberdyne, which produces a robotic exoskeleton to support the physically impaired – incidentally, it is named HAL (Hybrid Assistive Limb), again a pun on "2001: a Space Odissey" evil supercomputer. Cyberdyne maintains a strict policy over its shares, concentrating voting rights in the hands of its creator "for the purpose of ensuring the Company's advanced technologies are used for peaceful purposes, and preventing the misuse of these technologies to harm humans or to create military weapons[90]".

In conclusion, *Rōjin Z* testify the existence of a different imaginary that, although sharing the same cultural background as that proposed by institutions, reaches radically different conclusions.

[90] "Investor Relations", Cyberdine, accessed February 10, 2023, https://www.cyberdyne.jp/english/company/IR.html.

Conclusions

To conclude my thesis, I wish to reassume the findings of my research and discuss the many questions that these findings raise, then to address the limits of this work and suggest some perspectives for future research.

This thesis fits into a growing corpus of interdisciplinary literature on service robots in Japan that have analyzed their development and production in relationship with cultural values and political agendas. It is important to stress once again that it is not only culture that influences the direction in which the development of robotic technologies proceeds, but that robots create culture as well. As robots make their way out of factories and into the larger horizons of society, the interactions between them and humans are bound to give birth to new practices and new values attached to them, or to modify existing ones; culture and practices that are the constituents of what we call culture. Thus, we must understand robots and culture in a relationship of reciprocal production. This was the premise of this thesis, rejecting the idea of culture as a fertile but immutable ground from which technology stems.

My main contributions to this line of thought, already established by previous studies, are the followings. First of all, I believe that this thesis has shown the applicability of the theoretical framework of sociotechnical imaginaries to the study of robots in Japan. Through this framework, my aim was to highlight the role of institutional actor in the process of development and diffusion of service robots and provide a systematical analysis of how the State advances a specific imaginary through policies, performances and regulations. The role of institutions can also be understood keeping in mind the relationship of reciprocal production between technology and culture: on one hand, institutions try to attach cultural values to developing technologies in order to direct their development along the desired lines and to promote their diffusion (shaping technology through culture); on the other, they use those technologies to reinforce national identity and nation branding on the international stage (shaping culture through technology).

My analysis also proves the validity of using different types of sources, considering both real and fictional robots. Imaginaries are in a way, born out of fiction, or rather, they are narratives of future collectively enacted. Imagined technologies, especially when produced by powerful social actors such as institutions and corporations, are thus the starting point for the

development of real ones and often condense into them the values and aspirations that inform those sociotechnical imaginaries.

What I consider the most interesting result of my research is that a pattern of state intervention in technology development has emerged from the analysis of service robot policies that seems to extend to other fields, not just robotics. The sociotechnical imaginary of service robots, thus, should be understood as part of a wider imaginary that sees technology as a national resource and seeks to utilize it to preserve the status of the country as an economic power, and to reorganize and rationalize not only entire economic sectors but also the ways of life of citizens in response to a perceived crisis that is expected to sweep the country. I believe that this perspective should be taken into consideration when approaching the history of S&T in Japan in the new millennium.

Finally, the last finding that emerged through my thesis is that there seems to be a detachment between the sociotechnical imaginary proposed by Japanese institutions and the desires and needs of citizens. The conflict between the institutional vision of service robotics and those of other social actors in Japan has been particularly visible in the field of care robots, but it is not unlikely that examples of it could be found in other fields – such as the agricultural industry, another sector for which there are high expectations of an increased automation of production – and in relationship to other technologies such as ICT and the process of digitalization.

This last point raises a number of questions which I have only touched on briefly but that represents, in my opinion, one important direction for future possible research. Why have service robots failed to achieve a significant diffusion in Japan despite more than 20 years of promotion by the institutions? Of course, it might be simply a question of time: the development of these technologies is still in an early stage; however, there are other hypotheses that should be investigated. Is the sociotechnical imaginary advanced by institutions causing to lock into a technology that is actually not optimal to address the issues it is supposed to? Or perhaps there are unaddressed organizational or cultural features that prevent to fully exploit the possibilities of these technology? The sophisticate performance of the imaginary staged by institutions, then, could be perhaps read precisely as a symptom of a difficulty to transfer a vision elaborated by a narrow group of social actors out of staged environments and into the wider sphere of society. While, on the surface, there seem to be no evident tension, no luddite pulsion for a visceral refusal of robots, ignorance and oblivion are even stronger forms of resistance.

Now, to get to the limits of this elaborate, I believe that the most evident flaw is the limited set of data used. Policies represent a fertile ground to understand how institutions frame and develop a vision of future, but their analysis should be complemented by that of their reception by media, by experts and other social actors, to achieve a better understanding of the negotiations (or lack thereof) behind their creation and development. Megaevents have proven to be a precious source for information on how institutions stage the performance of the imagined future, but my analysis lack in depth that could have been achieved if fieldwork had been conducted during such events.

Another flaw is the absence of comparison. The framework of sociotechnical imaginaries emerged from comparison of national systems of energy production, and comparison between different patterns of evolution of technologies in different contexts is the most obvious application of this concept. This represents, I believe, one of the most important future prospects to continue this research, and it is a field that has been rarely touched by previous studies.

In conclusion, I wish to remark that the intention of this thesis was not that of judging the nature of service robots or of their application. I deliberately avoided delving too deep into the myriads of ethical dilemmas that the introduction of service robots into society poses to us. However, in questioning how institutions envision a future society through robotic technologies, there emerges also a vision of a specific social order sustained by existing power structures. It is impossible to think of service robots and care robots without arising some concerns. To what extent can go the surveillance offered by robots to ensure a safe and secure society? Who will be able to afford robotic care? When does the replacement of human interactions with human-robot interactions enriches life and when does it, on the contrary, creates alienation? In a context of growing inequalities, who will harvest the fruits of the increased productivity that the vision of a roboticized society imply? Answering these questions should be an imperative for a country that marches steadily towards a dream of coexistence between human and robots.

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