

Lost Opportunity Costs of "Robot Replacement" and the Way to Crack it

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Abstract

Based on the disappearance of the labor dividend and scientific and technological advances, the development of intelligent manufacturing industry represented by robot replacement. Although the robot may lose some of the "good characteristics" of the traditional manufacturing industry, such as manual labor flexibility, the use of a wide range of traditional employing enterprises less pressure on financing, unemployment shock is more moderate, corporate culture warm, etc., but as long as we pay attention to the localization of the core technology, pay attention to the diversification of financing, the operation of robots and the targeted vocational education, focus on the construction of corporate culture in the era of robots, we will certainly overcome these opportunity cost losses. Relevant vocational education targeted, focus on the construction of corporate culture in the era of robotics, we will surely overcome these lost opportunity costs and create a new industrial civilization in the era of robotics.

Keywords

Robot Replacement; Opportunity Cost; Technological Innovation; Corporate Culture; Cracking Countermeasures.

1. Introduction

In recent years, China's industrial robotics industry has developed rapidly. Zhejiang, Guangdong, Chongqing, Shanghai and other places have put forward the strategic goal of machine substitution of manpower, industrial production mode is changing from general "manufacturing" to "intellectual". At present, the field of machine for manpower has been gradually expanded to electrical and mechanical manufacturing, textile and garment, chemical, paper, furniture, electronic information and other industries. 2017 the State Council promulgated the "new generation of artificial intelligence development plan" to 2021 promulgated the "14th Five-Year" Robotics Industry Development Plan also highlights the national level for the development of industrial robots (including machine-for-manpower projects). robot development (including the machine-for-man project) is strongly supported.

The main reason why we use machine for man, its main reason can be summarized as, on the one hand, consider the need for technological upgrading, through machine for man can improve labor productivity. On the other hand, the high cost of labor, labor and employment structure needs to be adjusted, the repeated use of robots can reduce costs. Again, for occupational health and safety considerations.

In addition to domestic industrial enterprises to reduce the number of employees and improve efficiency factors, "machine replacement" and international market competition. In recent years, due to the impact of the new crown epidemic, developed countries weakened spending power, but the quality of the products required to enhance; coupled with the rapid development of the vast number of emerging economies, the production of products with some of China's "similarity", the only way for China to improve the quality of the products in order to compete in the increasingly competitive international market competition to win the advantage.

"Machine instead of man" helps to improve enterprise labor productivity, promote the stability of production and standardization of the degree of improvement, to protect the quality of large-scale production of products.

Although, machine for man has many benefits, but based on enterprise orders can not guarantee the continuity of supply, the lack of core technology of robot production, etc., machine for man is also facing the uncertainty of earnings, and at the same time the loss of traditional artificial production of all the good side, that is, faced with the loss of opportunity cost based on the labor to be replaced, and other issues. This requires the industry and the government and other public institutions to collaborate to overcome some of the disadvantages that may be brought about by the replacement of machines, and to promote China's manufacturing industry to the development of intelligent manufacturing.

2. Lost Opportunity Costs of "Robotics for Humans"

The so-called opportunity cost is the choice of a decision, that is, the loss of suboptimal decision, and the resulting loss of the possibility of (maximum) gain. From the perspective of this paper, the choice of robots for people, will face the loss of the possibility of traditional employment of labor gains, or bear the burden of traditional manufacturing itself does not have (that is, the traditional industry to reduce or no pressure in this area of the burden, which is the machine on behalf of a certain degree of "gain" loss). Although this is the inevitable result of robot replacement, but we still need to take measures to minimize this "growing loss" to bring us trouble, but also to alleviate the people on the robot replacement of all kinds of questions. Compared to the traditional system of employing employees, robots may face the following opportunity cost losses.

2.1. Benefits of Manual Use

2.1.1. Flexible Use of Labor

Artificial use is relatively flexible, and the general robot for repetitive labor links are better, if these operational links recur, the use of robots can undoubtedly save manpower, but at present, many small and medium-sized orders are not continuous, the use of robots instead of manual labor, will face the problem of wasteful idleness. For example, some factories to pull the machine over the use of less than a week, the production of orders are done, the machine is idle, and in the existing technology these specialized robots are also very difficult to transfer to do other work. General traditional use of manual labor enterprises, the number of enterprises can be adjusted flexibly according to the number of orders; at the same time in the acceptance of different product orders, but also a little bit of training for existing workers so that they are ready to change, that is, by the production of a certain product positions to another product production positions (especially in the inability to timely recruitment of relevant technical workers). In short, traditional enterprises have more room for choice in the use of labor.

2.1.2. Wide Range of Manual Use

Robot compared to traditional labor, some industries will be limited in use. That is, not all manufacturing industries or production processes can be replaced by robots in production, that is, including the use of robots over the years more industries, such as textile industry, some of the production aspects of the robot will not do well or can not do. And other types of work, such as quality control (especially the quality of the product quality control of the robot itself), customer service, product design, etc. Currently robots can not replace or can not completely replace manual labor.

2.2. Relatively Less Pressure on Financing

Compared to smart manufacturing, traditional manufacturing has and has had pressure to raise capital, but the pressure is reduced because the demand is relatively small. The cost of industrial robots is expensive, and the high cost of replacing them leads to high pressure on companies to raise capital. Moreover, as mentioned above, robots may be useless after the target product is made. In addition, if you want to produce other products, then the robot production line transformation is a relatively large project, the cost of investment will be very high, and the need for a few years to see the benefits, which undoubtedly increased the desire to improve the output efficiency of enterprises through the replacement of machine capital mobilization pressure, especially small and medium-sized enterprises.

2.3. Machine Repair and Maintenance Costs are Relatively Low

No robot use of traditional enterprises less robot repair and maintenance expenditures, although there are general machinery maintenance costs, but compared to the use of robots and maintenance, whether it is the configuration of parts and components, or the cost of labor costs are much less. The use of robots to replace the maintenance costs of enterprises increased greatly, the reasons are mainly the following two aspects.

First, the lack of core technology. Currently, the number of Chinese robots accounted for more than one-third of the number of robots in the world, but most of the robots use foreign core parts (high-end key components rely on imports), and then assembled by themselves [1], and the industrial robotics field of the top 15 globally important patent applicants (enterprises), there is no one belonging to China [2]. Only to enhance the performance of the robot's key core technology (especially the core components production technology) control in their own hands, robot replacement maintenance costs can be reduced, the future use of a more convenient, wider range of independent property rights of robots may also be available as soon as possible, and there will be more profit margins.

Secondly, the shortage of specialized technical personnel. The so-called robots for people, not without people, such as machine operation failure maintenance, system design and transformation of the corresponding technical staff are required. However, China's current robotics talent is still scarce, this side is due to the high technical content of robotics, professional knowledge requirements of a wide range; robotics characteristics of various industries is obvious, the differences are large, the difficulty of personnel training has been very high. On the other hand, the system of cooperation between enterprises and external organizations to cultivate robotics talents is not sound. In short, due to the small number of robotics personnel training, resulting in an overall scarcity of robotics personnel, which invariably raises the cost of operation and maintenance of robots.

2.4. Relative Easing of the Problem of Unemployed People

It is generally believed that the traditional enterprise staff reduction and efficiency is a relatively slow and gradual process. Generally from a certain industry enterprises began to reduce the number of employees, and then gradually extend the deployment. But the introduction of robots, especially in some economically developed regions based on technological innovation to improve the competitiveness of products in the international market needs, may be a short-term multi-industry at the same time to promote the use of robots on a large scale, and accordingly the total increase in demand for robotics operators or service personnel scale is limited, in addition, the robotics industry derived from the employment of other industries based on the short-term training is not in place there will be a small amount of employment Problems, in short, may lead to a sharp decline in the short-term employment of the population, the development of the economy and society will bring a certain impact (in particular, it will cause a part of the work content of simple and repetitive people out of work).

Although the replacement of human jobs by robots will trigger new demands and jobs, such as the use of manipulators or small robots to replace part of the labor force on the assembly line, the operation and maintenance of these new equipments will still need to be taken care of by human beings.

In addition, although the high-tech industry represented by robots replacing humans has a higher employment elasticity in the overall manufacturing industry, the industrial upgrading itself will bring about a higher growth in output value, which ensures an increase in employment and enhances inter-industry correlation, which will lead to a more refined industrial division of labor and give rise to new industries and jobs. However, it is true that all these new jobs require more technical training and continuous updating of employees' knowledge and concepts in order to be applicable to the new occupational needs. This also requires a long process of market selection and debugging, during which "structural" unemployment will also occur.

2.5. A more Welcoming Corporate Culture

Robots instead of people, standardized production instead of manual individualized production. But the traditional artificial production of close collaboration between people warm tacit understanding, flexible enterprise management culture factors also faded. Although the operator of the machine is also a person, but due to the operator is small, the staff work directly with the time is short, the employees are only mechanical completion of the work with each other, based on close contact and frequent collaboration in the work of the relationship generated (mutual wisdom collision of the sense of innovation and cooperation) may also be reduced. In particular, this phenomenon is especially prominent in companies that have just started using robots to replace people, and there is a need to further cultivate a new identity and collaborative relationship between people and machines, and between people and people in the age of robotics, i.e., to establish a new type of corporate culture in the age of robotics.

3. Key Strategies to Address the Lost Opportunity Costs of "Robot Replacement"

As mentioned above, the opportunity cost of robots to replace people is the necessary price to shift from traditional manufacturing to intelligent manufacturing. Even so, we can still be in the gradual adoption of robot production at the same time, the use of more scientific and reasonable methods to reduce these opportunity cost loss to us may be trapped, in order to more smoothly realize the goal of the machine for man, promote China's manufacturing industry upgrading.

3.1. Improvement of Robot Production Technology and Expansion of Its Flexible Use of Space, with a View to Saving the Cost of Machine Replacement Expenditure

First of all, cultivate core technologies, including key components production technology, especially the overall production of robots (including key components production and the transformation of the corresponding production line) core technologies that can be transferred (multi-position universal) use, is to promote the production of robots to use a wide range of labor, saving the local business expenses, i.e., the fundamental initiative of the cost of enterprise replacement.

In order to develop reliable replacement robots, the first priority is to encourage industrial robotics companies to develop and innovate, and to enhance the competitiveness of their own brands. At present, efforts should be focused on cultivating a number of leading enterprises with international influence [3].

Secondly, encourage the development of intelligent manufacturing aggregation. In particular, it actively cultivates industrial robotics industry characteristic parks, encourages enterprises to cooperate with each other, and reduces the cost of core component research and development and production, etc.. Through the agglomeration effect, the competitiveness and innovation ability of the whole industrial chain can be improved.

Again, give full play to the role of industry associations. Industry associations play an important role in the promotion of robot research and development. That is, to give full play to its role in robotics new technology and new products publicity and promotion (so that enterprises recognize the advantages of robot replacement); to promote industry self-regulation, promote the healthy development of independent brand robots; to maintain a fair competitive environment in the industry, and build a platform for technical exchanges and cooperation. Promote the continuous growth of the robot industry...

Through the implementation of the above measures, we can further promote the development of industrial robots, improve the ability of independent innovation and competitiveness, promote the synergistic development of the robotics industry and small and medium-sized enterprises, and realize the goal of robot replacement.

Fourth, emphasize the combination of policy support to promote the robot diversified R & D products on the market. Various places are exploring characteristic policies to support the production of robots. For example, Dongguan City has formulated a policy document to accelerate the development of industrial robotics intelligent equipment industry to support the promotion of robot product development. The Guangdong Provincial Government has also issued and implemented the Guangdong Intelligent Manufacturing Development Plan (2015-2025), which focuses on supporting the research and development and wide application of core components of industrial robots (e.g., bodies, controllers, speed reducers, servo motors, etc.). Corresponding safeguards have also been developed. Jiaying City and Haining City, Zhejiang Province, and Wuxi City, Jiangsu Province, have taken the opportunity of robot replacement to explore the localization of robot production technology and expand the use of robots in the simulation of manual judgment, automatic detection, intelligent simulation, automatic troubleshooting and other high-end technology links.

3.2. The Implementation of Diversified Financing Support

The implementation of diversified financing support, as far as possible to eliminate the machine for human capital (financing) pressure. Currently, the government should implement financial support for the adoption of machine generation enterprises. In general, the main three aspects. First, the use of existing intelligent manufacturing equipment, Internet of Things, small and medium-sized enterprise technology transformation and other special funds to support and guide enterprises to carry out the transformation of robot replacement. Second, implement preferential policies on interest rates for medium- and long-term loans for important projects where robots replace human labor. Third, the establishment of industrial enterprise emergency transfer fund, give priority to meet the "robot substitution of manpower" project funding needs. On the issue of machine for manpower financing, all over the world are also exploring feasible ways. Zhejiang Jiaying, Yongkang, Dongyang and other cities in the annual plan to invest in technological transformation of special funds to encourage enterprises to introduce relevant equipment, promote technological innovation, the implementation of machine-for-man technology. Dongguan City, the use of "Science and Technology Dongguan" project special funds to promote the implementation of robots to replace manpower program [4]. Municipal government support for private enterprises, village collective organizations to form a robot leasing company for small and medium-sized enterprises to provide equipment leasing services, to be such small and medium-sized enterprises to grow in strength, and then seek to sell the equipment to the enterprise, in order to achieve the robotics intelligent equipment industry

and small and medium-sized enterprises robots for manpower linked to the development of the goal.

3.3. Specialized Skills Training to Enhance the Employment and Re-employment Skills of Relevant Personnel, in Order to Reduce the Cost of Robot Use and Maintenance and Alleviate the Pressure on Social Employment

With the high-end of the industry, especially the development of high-end manufacturing industry, will increase the demand for knowledge-based employees, manufacturing, operation, debugging, maintenance of intelligent equipment, technical positions will be relatively increased. Therefore, a large number of automation, intelligent equipment should be trained to match the high-quality personnel to adapt to the new industry, the demand for new jobs; local comprehensive skills increase will undoubtedly reduce the use of robots in China to maintain the cost pressure. In addition, should also pay attention to based on the enterprise machine generation out of the staff of the "other skills compensation class" education, to promote their employment in a wider range of fields, to alleviate the employment pressure brought about by the robot replacement.

3.3.1. Implementing Comprehensive Human Resources Development Measures in Close Cooperation with Companies to Meet the Needs of "Robotics for Human Replacement"

First of all, the design of talent training program should reflect the "comprehensive" color. In addition to improving the general knowledge courses such as the principle of robot manufacturing, we should also pay attention to the systematic and comprehensive nature of related theoretical courses and experimental teaching. That is, although (robotics-related) different professional learning focus is different, but all kinds of course modules (including experimental courses) should reflect the complete, systematic and comprehensive requirements, which is conducive to students to better choose the combination of courses, and promote the improvement of their overall quality. First, improve the robot operation course module. Robot work links include traditional mechanical grasping, sensor control and pneumatic drive. Based on this, in the curriculum and development, the teaching content of mechanical, sensing, control, pneumatic and drive technology should be fully considered, and focus on the combination of content modules to start the course. Secondly, sound robot service course modules. Robot debugging and maintenance; robot sales promotion and after-sales technical support, design, operation and maintenance of industrial automation production lines; design and installation of robotic workstations and other courses should be systematically offered, through similar course development, with a view to providing comprehensive knowledge in the area of robot services. Third, conduct comprehensive simulation experiments. School internships, practical training and social services should be closely aligned with emerging industries. Based on the design of digital intelligent factory, it can integrate the professional laboratory platforms of machine manufacturing and design, computer control, computer network, mobile communication technology, etc., to establish a comprehensive intelligent factory laboratory, so that students can implement experiments of multiple courses in one experimental position. By perfecting the teaching and enterprise and industry "zero distance" docking composite laboratory construction, for the comprehensive quality training of talents also provides the basic conditions. Fourth, to adapt to the demand for robots, to provide a wider range of quality education course modules for students to choose, in order to achieve the cultivation of composite talent requirements. Robotics era talent training, the basic trend is to focus on skill-based to quality-oriented transformation, from training "a skill" to cultivate "multi-talented". Therefore, institutions are required to shift from general job skills training to comprehensive ability training (training). To this end, we should break the boundaries of

specialization and start the "specialization +" mode. Introduce some "workshops" with technical, skill and management education characteristics into the campus to cultivate professional "artisan" talents who are integrated with culture, intelligence, technology and management. Skilled personnel should have the following qualities: innovative thinking; computational thinking; literacy in new media; interdisciplinary skills; design conceptual skills; intercultural competitiveness; project development and management skills; and virtual collaboration skills. This should also lead to the creation of relevant courses for students to take. In addition, relevant courses on internationalization should be offered in cooperation with foreign universities to broaden students' knowledge horizons. To this end, we need to strengthen exchanges with foreign universities, establish a mechanism for mutual assistance in talent training, and promote the normalization of talent training.

Secondly, deepen the cooperation with enterprises and innovate the way of talent cultivation. In the daily teaching, work practice, production engineering training and practice courses and other aspects of close cooperation with enterprises in various forms, training to meet the needs of enterprises with a comprehensive quality of composite talents, and gradually formed "government guidance, enterprise-led, teacher and student participation, on-campus implementation, the market application of" talent training model. This model combines education, talent cultivation, accreditation, training, service and scientific and technological innovation research and application. In addition, it is particularly important to establish new types of strategic partnerships with leading enterprises in the industry, relying on the influence of these enterprises in the industry, to jointly formulate talent cultivation programs, develop professional curricula, and conduct teaching evaluations, etc., which will strongly contribute to the improvement of the quality of talent cultivation).

3.3.2. Focus on and Systematize the Development of "Skills Compensation Classes" after "Robotics Replacement" (Especially in All Types of Vocational Schools)

Traditional vocational education pays great attention to the interface between the teaching process and the production process, and implements order training and top-ranking internships. However, this mode of training is not only unable to meet the flexible needs of practitioners for further study and transfer to other jobs, but is also prone to the dilemma of "instrumentalization". As the production process becomes highly informatized, automated and intelligent, more attention should be paid to the comprehensive vocational ability of workers. At present, the requirements of many industrial enterprises on the ability and quality of employees have gradually shifted from the original job skills to the comprehensive vocational ability and quality of continuous improvement. (i.e., the requirements for dynamically changing qualification standards have been put forward in many aspects such as education and qualification certificates.)

Therefore, based on the major changes in the employment structure of the labor market triggered by the replacement of robots, vocational education should pay attention to improving the content of vocational training. In particular, it should pay attention to the "post-vocational education" [5], that is, the need for vocational education and training functions of the extension and deepening of vocational education and training - the need to strengthen vocational education and skills compensation training, training for the improvement of the quality of the staff of the comprehensive type; the need to deepen the continuing education and vocational qualification training for employees in the enterprise. Education and vocational qualification training. To a certain extent, these vocational trainings can be regarded as the "skill compensation" education for employees in order to satisfy the continuation of their jobs.

The "skills compensation" education, in a broad sense, includes the technical continuing education training or knowledge updating training for those who can still work in the original enterprise, as well as the training for obtaining new vocational qualifications, etc. It also

includes the training for those who have been displaced from their original enterprises. It also includes the "transfer" training of employees who have been displaced from their former enterprises. Continuing education of the original enterprise staff focus on the original job skills to upgrade, can be linked to the general college or vocational college special training programs. The "transfer" training, that is, the machine generation after the outflow of employees other vocational training, can be included in the government's general vocational education to support the name, support various types of vocational colleges and universities to the community to open up the training resources to the free or preferential way for the machine generation after the outflow of employees or other social personnel to provide short-term (non-robot) skills training programs. The Government should include the amount of social training undertaken by vocational colleges and universities as one of the assessment criteria for measuring the level of development of vocational education in such institutions.

3.4. Reshaping the New Corporate Culture

The construction of enterprise culture in the era of robots, should pay attention to the cultivation of collaboration culture with machines as the carrier, pay attention to the robot operation drills, cultivate closer articulation and cooperation between robot operators. That is, in the exercise to develop a more close cooperation with each other, to promote human-machine and human collaboration, in the continuous exercise and work collaboration to gradually reach a tacit understanding of cooperation, the formation of the robot era, "the new style of cooperation" of the cultural identity. Strengthening data sharing in the construction of intelligent manufacturing enterprise culture in the Internet era, and endeavoring to better deal with indirect cooperation and remote cooperation mediated by robots.

Strengthen the data sharing of intelligent manufacturing enterprise culture construction in the Internet era, and strive to better deal with the indirect cooperation and remote collaboration mediated by robots, and change the cultural identity mode of traditional manufacturing industry, which is only close interpersonal relationship collaboration.

4. Conclusion

Robot replacement is an inevitable trend in the development of China's manufacturing industry, to a certain extent, to reduce the expenditure of enterprise labor costs, improve the efficiency of enterprise production and product quality. Of course, at the same time will lose some of the advantages of traditional artificial production, such as the use of flexible labor, the cost of production equipment is low, the easing of financing pressures and the impact on the employment of the overall more moderate, the enterprise's cultural construction, "humane" thicker, more warm and so on. However, as long as we focus on the improvement of intelligent robot manufacturing technology, reduce the necessary costs, focus on multi-level financing support, carry out a diverse range of special education, as well as focusing on the transmission and sharing of digitalization in the era of robotics, and cultivate a new cultural sample of the smart manufacturing enterprises, we will overcome the loss of these opportunity costs to us, and open up a new chapter in the era of robotics in the advanced manufacturing industry.

With the disappearance of the demographic dividend, machine generation has become a trend of modern industrial development, but the current consumer pursuit of personalized products and robot standardized production products have an inherent conflict (i.e., robots can not provide personalized, flexible customization); in addition, industrial robots also lack logical judgment, decision-making, communication ability and strong innovation ability, even if currently improved by digital intelligence, but also can not be fully Compare with artificial, this may be the robot labor in the future need to continue to improve the place.

References

- [1] Chinese Institute of Electronics: China robotics industry development report (2018) [R].2019.
- [2] Smart City Editorial Department: 2017 China industrial robot industry development trend analysis [J]. Smart City,(2017),3(4), p.21.
- [3] YEEO GLOBAL: 20 Chinese industrial robotics companies with global competitiveness[DB/OL]. (2022-11-01) [2023-8-24]. <https://baijiahao.baidu.com/s?id=1748268275866406978&wfr=spider&for=pc>.
- [4] Y.M. Li, C. Li: Dongguan, Guangdong pry tens of billions of funds to support enterprise "machine for man" [DB/OL]. (2016-06-30) [2023-8-22].
- [5] https://www.sohu.com/a/100292796_219967.
- [6] G.Q. Xu: Vocational education curriculum theory [M]. (East China Normal University Press, China 2015) , p.92.