

A Study on All-Round Human Development in the Era of Digital Technology

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Abstract

Digital technology is reshaping production, labor, communication, and daily life. These changes give Marx's theory of all-round human development a new field in which to show its explanatory power. Taking that theory as the main framework, this paper discusses how digital technology may raise productivity, widen social contact, and open new spaces for learning and creation. It also points to problems that cannot be ignored: work time may spread into private life, the digital divide may widen old inequalities, and algorithmic systems may weaken workers' subject position. The paper argues that digital technology should be judged not only by speed, scale, or efficiency, but also by a more basic question: does it help real people gain freer time, richer abilities, and more equal social relations? To answer this question, the paper proposes several paths, including better platform governance, clearer labor protection, stronger public digital services, digital literacy education, humanistic education, and institutional protection of workers' free time.

Keywords

Marxism; all-round human development; digital technology; social relations; technological governance; free time; digital divide.

1. Introduction

Since the beginning of the twenty-first century, intelligent factories, unmanned operation, artificial intelligence, big data, cloud computing, and the digital economy have moved from specialized technical fields into ordinary social life. Factories use sensors and industrial software; schools use online platforms; public services rely on codes, apps, and databases; workers communicate through messages long after they have left the office. This change has raised social labor productivity in many industries and has reduced some heavy or dangerous manual tasks. Some scholars have noted that technological progress may free people from painful labor and make up for limits in human ability [1]. This possibility is important for Marxist theory, because the saving of labor time and the growth of social wealth can, under suitable social conditions, support human development.

Technology, however, never works outside social relations. Capital pursues profit, law often lags behind new forms of work, and social protection does not always reach platform labor or remote labor in time. Because of this, new tools may be used to draw more surplus value from workers, although the method looks different from the old factory system. The phrase 'off work but still online' describes a familiar situation. A worker may close the office door, yet still answer messages, attend online meetings, check data dashboards, or wait for a platform order. Digital interfaces, data traces, rankings, and algorithmic schedules have made labor more mobile, but also more difficult to separate from private life.

During the 2024 sessions of the National People's Congress and the Chinese People's Political Consultative Conference, proposals on the right to offline rest and on the stronger

implementation of paid annual leave drew wide attention. The Third Plenary Session of the 20th Central Committee of the Communist Party of China also stressed a health-first development strategy. These debates show a clear social demand: workers want time that can really be used by themselves. The issue is not whether digital technology should be developed. It is how society should guide, limit, and use it, so that technical progress does not quietly become a new pressure on human life.

Marx's theory of all-round human development offers a useful standard for this discussion. The theory does not treat human progress as a simple increase in skills, nor does it equate development with economic growth alone. Marx was concerned with the development of human abilities, needs, individuality, social relations, spiritual life, and practical activity. A technology has value for human development when it helps people use their powers more freely and enter richer social relations. If the same technology is used mainly to monitor workers, extend work time, intensify competition, or turn people into data resources, its value becomes doubtful, even if it is technically advanced.

The digital era therefore changes more than the background of an old theoretical issue. It changes the concrete forms of labor, need, communication, learning, and self-formation. Work may be organized through apps. Social contact may be mediated by platforms. Education may depend on digital resources. Even leisure may be counted, recommended, and monetized. For this reason, all-round human development must be examined together with the structures of technology, capital, public policy, and everyday life. A purely technical view would ask only whether a system is efficient. A Marxist view must also ask who benefits, who bears the cost, and whether human beings become freer through the process.

This inquiry also has practical meaning for contemporary governance. Digital transformation has already entered education, health care, culture, public administration, community life, and interpersonal communication. In such an environment, people need technical skills, but skills alone are not enough. They also need fair access to resources, the ability to judge information, the right to refuse excessive online work, and enough time for study, rest, family life, and public participation. This paper therefore examines digital technology from the angle of productivity, labor, social relations, public supply, and human subjectivity, rather than treating it as a neutral tool.

The paper keeps this problem within the frame of Marxist theory, but it does not treat the theory as a fixed formula. The point is to use it to read new facts. The smartphone, the platform order, the online meeting, and the recommendation algorithm are not objects that Marx could have described directly. Still, the relations behind them - labor time, ownership, surplus value, social contact, and human freedom - are questions that his method can illuminate. This is why the article moves between theory and present social life. It asks how an old theoretical concern appears in a new technical form.

2. Core Connotations of Marx's Theory of All-Round Human Development

2.1. The Generative Logic of All-Round Human Development

The idea of all-round human development has a long history. It did not appear suddenly in Marx's writings. Its early elements can already be seen in ancient Greek thought, where philosophers moved beyond the question of bare survival and began to discuss art, beauty, virtue, and the cultivation of the person. Pythagoras connected beauty with numerical harmony. Aristotle discussed beauty in relation to form, technique, and expression. These reflections suggest that the Greeks did not understand human life as eating, working, and surviving only. They also valued the training of aesthetic, ethical, and intellectual capacities. This early concern supplied one cultural source for later thinking about the development of the whole person [2].

The Renaissance pushed this concern further. Humanist writers opposed the anti-human tendencies of medieval religious thought and emphasized the dignity and value of the person. The Enlightenment then placed reason, emotion, and individual subjectivity at the center of social criticism. These movements gave the theory of human development a richer language. But they also had limits. They often spoke of human nature in abstract terms, while the social and economic conditions that make real development possible remained insufficiently analyzed.

Marx changed the question by grounding it in real social relations and material production. In his early text 'Reflections of a Young Man on the Choice of a Profession,' Marx argued that a meaningful occupation should serve the welfare of humanity. In the Economic and Philosophic Manuscripts of 1844, he analyzed alienated labor. There, the worker becomes estranged from the labor process, the product of labor, species-being, and other people. For Marx, this alienation was not a problem of feeling alone. It was rooted in private property and in a social order that separated workers from the conditions and results of their own activity.

Later, Marx and Engels developed the idea in works such as *The Communist Manifesto* and *The Poverty of Philosophy*. They discussed labor, class emancipation, social relations, and the future form of association in which the free development of each person becomes the condition for the free development of all. In the present period, artificial intelligence, the Internet of Things, and big data are changing production and everyday life at high speed. Yet the problem that Marx described has not disappeared. Workers still face a shortage of free time, and digital convenience can hide that shortage instead of removing it. The current task is to connect Marxist principles with China's concrete reality and to use the theory to guide the digital transformation of social life.

This historical line shows that Marx did not present human development as a moral ideal detached from social practice. He tied freedom to the transformation of production and social relations. Earlier humanist thought valued the person, but Marx explained why people become one-sided under a certain mode of production, a certain division of labor, and a certain structure of domination. The same point matters today. Digital technology often appears as an autonomous force that people can only accept. Marx's method reminds us to look behind the device or platform and ask about ownership, labor organization, public rules, and social purposes.

2.2. The Theoretical Connotations of All-Round Human Development

For Marx, all-round human development means that human beings appropriate their own rich essence as complete human beings. This statement is abstract, but its meaning becomes clear once it is placed in social life. Marx did not speak of an isolated individual who develops in private and outside history. He spoke of real people who work, communicate, suffer, learn, create, and act under definite conditions. A person is free and creative, but that freedom is always shaped by the social relations in which the person lives. Since the real person is the ensemble of social relations, the development of the individual is also the development of the relations through which the individual exists [3].

All-round development includes several dimensions. It involves the body, labor ability, intellect, moral judgment, aesthetic experience, communication, and participation in social life. These dimensions should not be treated as separate boxes. A worker who has strong technical skills but no time for family, public life, or reflection is still one-sided. A person who has access to online information but lacks the ability to judge and use it is also not fully developed. The point is not to list every possible ability, but to clarify the conditions that allow people to unfold their capacities in a balanced way.

The first condition is the development of productive forces. Without enough material wealth, basic needs such as food, housing, transport, education, and medical care cannot be met. In such

a situation, talk of all-round development easily becomes empty. The second condition is free time. Marx drew on earlier socialist thinkers and writers such as Schultz when he noted the importance of time for spiritual creation and enjoyment [4]. Human activities always require time. A person who spends most of the day under heavy work pressure can hardly engage in reading, art, public affairs, exercise, or careful reflection. Leisure then becomes no more than recovery from fatigue.

Free time should therefore be treated as a real developmental condition, not as a luxury after work. When digital tools save time in production, society must ask where the saved time goes. Does it become free time for workers, or does it become more tasks, faster assessment, and longer availability? This question is central in the digital era. Technology can make work easier, but without rules it can also turn every quiet moment into a possible work moment. The promise of saving labor time is lost when mobile communication and platform systems bring work back into the home.

The third condition is the development of social relations. Human beings become themselves through interaction and practical activity. Narrow relations produce narrow development. If communication is limited by region, class, occupation, race, or unequal access to resources, individual capacities are also limited. More open and cooperative relations help people see beyond their immediate environment and understand the restrictions placed on them. Individual development and social development thus support one another. When people gain richer individuality, they also enrich social communication through understanding, cooperation, and creative practice.

A fourth condition is the relation between human beings and nature. Under the logic of capital, nature is often viewed mainly as a source of profit. Its beauty, order, and life-supporting value are pushed aside. Human development cannot be complete if it is built on the destruction of the natural world. Respecting natural laws and restraining the short-term pursuit of profit are not external additions to the theory. They form part of the social conditions under which people can live, work, and develop in a sustainable way.

These conditions are linked. Productive forces can create material abundance, but social institutions decide whether abundance becomes free time and public welfare. Social relations can be widened by technology, but those relations may still be unequal if platforms control visibility and data. Education can cultivate spiritual life, but education needs both material support and time. Harmony with nature also depends on the purpose and organization of production. Marx's theory is systematic for this reason. It asks not only whether people have more options, but also whether the conditions behind those options are fair, rational, and directed toward human flourishing.

3. Technological Innovation Provides New Momentum for All-Round Human Development

3.1. The Improvement of Productivity Lays a Solid Foundation

Digital technology can supply new momentum for all-round human development, but the route is not automatic. In production, digital tools have changed the way people organize labor, equipment, information, and management. Industrial software, sensors, cloud platforms, and artificial intelligence allow producers to connect different links of production more closely than before. In some workplaces, repetitive tasks are reduced; in others, risky operations are carried out by machines. These changes can raise productivity and create a material basis for human development, as long as the gains are not kept by a narrow group.

One visible change lies in the mode of production. The Internet, artificial intelligence, big data, and industrial software help enterprises adjust production lines, coordinate supply chains,

communicate across departments, and respond to market demand. A design can be revised through a digital platform; a warehouse can be scheduled by data; a machine can report its fault before it stops. Such changes may reduce waste and lower the amount of repetitive labor. They also require workers to learn new skills and to cooperate with technical systems, rather than simply repeat fixed manual operations.

Intelligent equipment also changes the working environment. Compared with older tools, some intelligent machines reduce direct physical damage to workers. A robotic arm may take over dangerous lifting. An automatic inspection system may reduce the need for workers to stay in harmful environments for long periods. Software tools can also help workers collect information, calculate risks, compare plans, and make decisions. These forms of assistance do not remove human labor, but they may change its content. Workers may spend less energy on mechanical repetition and more energy on judgment, coordination, and problem solving.

Read in Marxist terms, this matter is not only about producing more goods. The deeper question is whether society can reduce necessary labor time and create room for people to develop other capacities. Human-machine cooperation has a positive meaning when it frees workers from dangerous, monotonous, or low-value tasks and gives them time and security for learning, creativity, and participation. If the new productivity only makes the pace of labor faster, the human value of technology is weakened. Distribution and labor protection therefore become part of the meaning of technological progress.

Productivity should not be treated as the same thing as all-round development. Digital production can reduce physical burdens and improve coordination, but it can also create dependence on platforms, algorithms, and data systems. When firms use intelligent equipment mainly to monitor speed, rank workers, or push output targets higher, workers may experience stronger pressure, not greater freedom. For this reason, the social meaning of productivity growth must be judged by its effect on workers' lives: Does it expand choice? Does it leave time for education and rest? Does it support participation and creativity?

The positive side of digital productive forces becomes clearer when technical innovation is joined with institutional innovation. Training, occupational protection, reasonable workload rules, and mechanisms for sharing technical gains should accompany the use of intelligent systems. Otherwise, workers may be treated as replaceable attachments to machines. A people-centered arrangement would allow them to cooperate with technology while improving their own capacities. In this way, digital technology can become an opportunity for human development rather than another form of control.

A further point should be added. Productivity in the digital era is not only a matter of machines replacing hands. It also concerns the way workers understand and control the labor process. If a worker only follows instructions generated by a system, the worker's activity may become narrower even when the machine is advanced. If the worker can understand the data, adjust the process, and discuss improvements with others, the same technology can become a means of learning. This difference is not small. It shows why training, workplace democracy, and transparent management should accompany technical upgrading. Digital equipment should not only make production faster; it should also help workers see the whole process more clearly and take part in shaping it. When this happens, the growth of productivity becomes connected with the growth of human ability.

3.2. Digital Platforms Facilitate Social Communication

Digital platforms have also changed the way people communicate. Online learning platforms, social media, forums, video platforms, and search engines allow people to contact others beyond the limits of workplace, hometown, and school. A student in a small city can listen to lectures from another region. A worker can join an online community related to a skill or an interest. A family member working far away can maintain daily contact through a screen. These

ordinary examples show how digital platforms can widen social relations and make communication less dependent on physical distance.

Some platform features may encourage more equal expression. Partial anonymity sometimes allows people who are shy, marginalized, or restricted by status to speak more openly. Online communities can also help people find information and emotional support that they would not easily find nearby. But this equality is fragile. Platform visibility is shaped by algorithms, traffic rules, advertising, and commercial promotion. Some voices are pushed to the front, while others are buried. The task is not simply to praise online communication, but to ask what kind of communication the platform rules produce.

Platforms also turn behavior into data. A person's learning record, search history, location, comments, likes, and consumption traces can be collected and reorganized into profiles. This datafication has two sides. It may help match educational resources, public services, job information, and cultural products with users' needs. It may also help individuals see their own learning habits more clearly. But when platforms own and use these data without enough public constraint, they gain a strong power to guide attention, shape choices, and make profit from everyday activity.

For this reason, the value of digital platforms depends on their social use. If data serve public services, education, cultural exchange, and fair employment, platforms can support human development. If data mainly serve commercial control, addictive recommendation, or traffic competition, social relations become thin and unstable. Users may feel connected, yet their contact is organized by ranking, comparison, and emotional stimulation. Digital communication then loses part of its human value. Platform governance must therefore protect privacy, reduce manipulation, and encourage forms of interaction that build trust and understanding.

Platform communication also reshapes public life. Traditional social relations often kept many people within a narrow circle defined by geography, occupation, income, and cultural resources. Digital platforms allow participation in public discussion, volunteer work, online consultation, cultural creation, and interest groups across those boundaries. Yet openness does not mean fairness. When traffic rules decide who is seen, the online public sphere can reproduce old inequalities in new forms. A platform with millions of users may still silence the voices of people who lack money, technical skill, or algorithmic visibility.

All-round human development needs communication that is more than instant reaction. People need spaces where they can explain, listen, disagree, cooperate, and form social responsibility. If platforms only train users to click, forward, argue, and consume, they weaken sociality while appearing to expand it. If platforms support knowledge sharing, community help, public reasoning, and cultural dialogue, they can become places where people develop communicative ability. Rules for platform design and governance should be judged by this standard, not only by user numbers or time spent online.

In daily platform life, this standard can be quite concrete. A discussion group that helps students solve reading problems, a community account that explains local public services, or an online mutual-aid group for workers can all expand social relations in a useful way. By contrast, a space filled only with rankings, quarrels, and emotional slogans may increase contact without deepening communication. The number of messages does not prove that social relations have become richer. What matters is whether people gain knowledge, trust, support, and the habit of public reasoning. Platform design should therefore leave room for slower discussion and reliable information. It should not reward only speed, conflict, and attention-catching expression. This is a practical requirement, not a decorative ethical claim.

3.3. Virtual Spaces Open Up Diverse Fields of Development

Virtual space gives human development another field of activity. Marx's all-round development is not the private self-improvement of an isolated individual; it is the unfolding of human

abilities and needs in real social relations. Digital courses, virtual laboratories, digital museums, creative communities, simulation systems, and intelligent learning tools loosen the limits of time and place. A person can study a subject after work, view cultural collections far from home, or join a collaborative project without being physically present. These experiences can expand knowledge, taste, and practical ability.

Individuals also use digital tools to create. They write, design, program, edit images, produce music, build models, and take part in open-source communities. Artificial intelligence-assisted creation and virtual reality can give imagination new technical forms. This does not mean that every online creation is deep or valuable. It means that the channels of cultural production are no longer limited to a small number of institutions. More people can try to express themselves, receive feedback, and improve through practice. This process matters for individuality, because people develop by doing, not by receiving information only.

The meaning of virtual space should not be reduced to entertainment. Entertainment is part of life, but virtual space can also support learning, aesthetic experience, social contact, and public participation. It may be especially useful for people in remote areas, people with limited mobility, or people whose local environment offers few cultural resources. Such groups can gain access to materials and communities that were once difficult to reach. In this sense, virtual space can widen the field in which people develop, although it cannot by itself remove inequality.

The condition is that digital space must serve human subjectivity. When a platform treats the user mainly as traffic, data, or a target for advertising, the user becomes less a subject of development than an object of capture. The decisive question is simple: does the digital environment help people think, learn, create, and communicate, or does it mainly hold their attention? A healthy digital space should strengthen judgment, aesthetic capacity, ethical awareness, and social participation. It should not make people dependent on endless recommendation and simulated satisfaction.

Virtual learning also changes the relation between knowledge and practice. Online courses and virtual experiments can offer materials that local schools or workplaces may not provide. Workers can use them for retraining; students can use them to broaden their studies; citizens can use them to understand public affairs. Yet online knowledge still has to return to real practice. A lesson that is watched but never used may create an illusion of improvement. Knowledge becomes part of human development only when people test it, revise it, and apply it in labor, communication, and social life.

Virtual space is therefore best understood as an extension of real social relations, not a replacement for them. A person who uses digital tools to learn a skill, solve a problem, cooperate with others, or create a work may return to real life with stronger capacities. A person who is drawn into endless entertainment and scattered information may lose time, patience, and contact with reality. The difference lies in whether the person remains an active subject. Governance of virtual space should not stop at blocking harmful content. It should also provide good resources, healthy cultural products, and guidance for rational use.

The same distinction is useful when discussing young people and digital education. A virtual experiment can help a student see a process that a classroom cannot easily show. A digital museum can give rural students access to collections that were once far away. But if the learning platform only pushes questions, scores, and rankings, it may train anxiety rather than curiosity. Teachers and families should help learners connect online materials with reading, discussion, writing, observation, and practice. The learner should not be left alone before a screen. In this sense, the value of virtual space depends on the social support around it. Digital resources become developmental resources only when schools, families, and communities help learners use them with purpose.

4. Practical Dilemmas of All-Round Human Development under Technological Change

4.1. The Loss of Free Time

Marx pointed out that one method by which factories pursue surplus value is to maximize the length of the working day [5]. In today's digital society, even though labor laws set limits on statutory working hours, the upgrading of communication tools and the application of remote office software have enabled new technologies to turn workers' life time into labor time in a new form [6]. Digital technology has increasingly penetrated daily culture, entertainment, and social life. Workers may unconsciously pay attention to work groups, messages from supervisors and colleagues, and other work-related digital content during rest time. Consequently, they remain in a state of unconscious or implicit labor even after the formal end of work.

This situation seriously deprives workers of freely disposable time. Their actual working hours often exceed the legally recognized working day. At the same time, technological progress has expanded the field of work. When workers cannot complete tasks during formal working hours, leaving the workplace no longer means entering rest time; it may mean the beginning of another period of unpaid labor. Marx once described the inversion in which workers do not use the conditions of labor, but rather the conditions of labor use the workers. In the digital era, this inversion appears in a new technical form: platforms, applications, and data systems continue to organize and summon labor even when workers are physically outside the workplace.

The widespread use of digital technology has made labor more invisible. A large amount of living labor has shifted from offline factories to online links such as artificial intelligence model creation, algorithmic coding, content moderation, data annotation, debugging, and platform maintenance. Workers no longer perform labor only in a factory or office. They can work in almost any space through digital tools. The labor space extends from the workplace to the home and to private living areas. The convenience and popularity of artificial intelligence also require intensified human-machine collaboration, and the workplace must extend into cyberspace. As a result, work becomes spatially dispersed but temporally continuous.

The extension of working time and the expansion of the working field have contradictory effects. On the one hand, they may improve the efficiency of digital product production, accelerate technological development, diversify career paths, and allow certain forms of flexible work. On the other hand, they deeply combine work and life. Popular fields such as live streaming, short-video production, and reality-based online performance are typical examples. The disappearance of privacy and leisure time, together with unstable income, can impose heavy physical and mental burdens on workers. It becomes increasingly difficult to distinguish working time from life time, and personal happiness and security are weakened. The essence of capital's exploitation of workers has not changed; it has only become more hidden and complex. Workers still lack leisure time that can be used for self-development.

Free time matters because it shows whether productivity has really been changed into human development. In digital workplaces, mobile communication, online collaboration systems, platform orders, and data assessment blur the boundary between work and non-work. A worker may appear to have flexible hours, but flexibility can become permanent availability. When messages may arrive at any time and performance indicators update in real time, workers often keep part of their attention attached to work. Rest then becomes shallow, and labor control moves inward, into the worker's habits, emotions, and self-discipline.

For Marx, free time is not simply the hours left after wage labor. It is the space in which people read, think, create, exercise, care for family members, join public life, and develop capacities beyond immediate necessity. If digital technology compresses this space, higher efficiency has

not produced richer human development. Rules on remote work, online overtime, platform scheduling, data monitoring, and the right to disconnect are therefore needed. More broadly, society should build a shared understanding that technical progress is valuable only when it allows people to live more fully, not merely work faster in a less visible way.

This point is easy to overlook because digital labor often does not look like labor. Answering one message takes only a minute. Checking one form may seem harmless. Watching a platform dashboard at night may be called responsibility. Yet these small actions accumulate. They break rest into pieces and make workers unable to enter a stable state of recovery or reflection. The worker may not be sitting in an office, but the mind still stays near the workplace. A proper system of labor protection should recognize this scattered labor. It should not count only visible hours inside a factory or office. Otherwise, the old problem of the working day will return in a quieter and harder-to-measure form.

4.2. The Decline of Bodily Functions and Reflective Capacity

Marx once criticized monotonous factory labor as boring and meaningless. He argued that being forced to watch an untiring machine for a long time was a cruel form of suffering for workers. Simple, meaningless, and prolonged labor consumed workers' bodies and damaged their spirit. If a person spends a lifetime performing only a few simple operations, that person lacks both the conditions for developing intelligence and the opportunity to use imagination to overcome difficulties [9]. Physical and mental exhaustion makes workers powerless to pursue their own development and may lead to unhealthy habits and impoverished forms of life.

Digital technology has brought convenience to modern life, but it also creates new pressures on the body and the mind. People can reach more information than before, but too much data, repeated content, and emotional stimulation may disturb careful thinking. Low-quality and unverified information circulates quickly. Hot topics receive high exposure, and recommendation systems often send users material similar to what they already prefer. In this way, some people gradually enter information cocoons. They hear fewer voices from other social groups, and their views may become more rigid.

Entertainment has also changed. Short videos, games, live streams, and other online products fill many people's leisure time. The problem is not entertainment itself. The problem appears when online entertainment replaces reading, exercise, face-to-face contact, and patient reflection. Long screen time, irregular schedules, and reduced physical activity can weaken the balanced development of body and mind. From the standpoint of all-round human development, this one-sided digital life narrows the range of human activity and leaves less energy for learning, communication, and creation.

Big data tracking deepens this problem. Browsing, likes, comments, purchases, pauses, and searches become measurable indicators. These indicators are then used to predict behavior, recommend content, and produce profit [7]. As rankings, guides, and algorithmic suggestions enter ordinary choices, people may follow paths designed by platforms without noticing it. Daily life becomes simpler and more predictable. Independent judgment may also weaken. For this reason, digital literacy should include not only technical operation, but also the ability to question information, recognize manipulation, and protect one's own attention.

The decline of reflective capacity is tied to the attention economy. Many digital products compete for time by using constant stimulation: notifications, trending topics, short clips, and personalized feeds. These products satisfy immediate curiosity, but they can break concentration. When users become accustomed to quick conclusions and strong emotions, they may lose patience for systematic reading and careful argument. This is not only a matter of weak self-control. It is linked to a business model in which attention becomes data and data become profit. Personal discipline is needed, but public regulation and platform responsibility are also needed.

The body should not be forgotten in this discussion. Human beings are not minds separated from bodies. Health, sensory experience, emotion, sleep, movement, and face-to-face cooperation all belong to a complete life. Heavy dependence on digital devices may reduce outdoor activity, disturb sleep, and increase anxiety produced by comparison and information overload. Digital tools should help people learn, work, communicate, and create. They should not replace embodied experience or real participation in the material world. Education and public culture need to guide people toward more balanced digital habits.

The issue is also connected with class and occupation. Some workers use digital devices mainly for leisure, but many others must stay online for work, delivery, customer service, remote meetings, content production, or platform orders. For them, the advice to use screens less is not enough. They need workload limits, predictable schedules, health protection, and a real right to rest. A courier who waits for orders, a streamer who depends on traffic, and an office worker who replies to messages at night face different forms of digital pressure. Policy should not treat these workers as if they had the same freedom to turn off devices. Bodily health in the digital era is therefore a social issue as well as an individual habit.

4.3. The Digital Divide and the Crisis of Technological Substitution

The digital divide refers to the inequality of opportunities for digital development caused by unequal access to digital infrastructure, equipment, knowledge, and skills [10]. First, technological development creates differences in people's ability to participate in the digital economy because of age, region, education level, income, and capacity for technological adaptation. As a result, there are also differences in the acquisition of digital dividends. People in remote areas may find it difficult to afford network services and smart devices and therefore cannot benefit equally from digital technology. Vulnerable groups may be unable to obtain information or defend their rights through digital means, causing them to fall behind in the digital era.

During the COVID-19 period, for example, some people could not obtain information about protective measures in time, and some elderly people could not keep up with digital procedures for shopping, medical treatment, travel, and public services. Children in remote areas may lack access to new technology education and thus face disadvantages in knowledge acquisition. In contrast, workers and professionals related to digital technology have more opportunities to obtain benefits through technological skills. Digital development often tends to serve high-income groups and economically developed regions first, which may make those who already master technology even stronger, while the disadvantaged are gradually left behind by the digital age.

Second, the combination of digital technology and intelligent manufacturing simplifies certain forms of labor and makes production increasingly automated and intelligent. The demand for medium- and low-skilled workers decreases in some industries. The trial operation of unmanned supermarkets and unmanned factories reveals the labor-substitution effect of manufacturing, retail, logistics, and service industries [8]. A large number of low-skilled workers face the risk of unemployment or marginalization. New employment opportunities are often concentrated in knowledge-intensive industries and tend to recruit highly skilled workers. The large differences in life opportunities produced by differences in information technology abilities may intensify inequality among people and restrict all-round human development.

Third, digital platforms may exploit ordinary workers through their control of advantageous means of labor. Platform users accumulate massive amounts of data for digital technology platforms, but the ownership and economic benefits of those data are often controlled by the platform. Workers and users may therefore be excluded from digital dividends. In addition, the distribution mechanism of platform income is unequal. Small and medium-sized digital workers often receive low returns from digital content. On e-commerce platforms, for example,

small streamers and merchants may face high withdrawal thresholds. Some digital workers are unable to obtain income even after contributing digital labor, and after reaching the withdrawal threshold they may still need to pay fees for exposure, promotion, and platform commissions. This weakens income security and may further widen the gap between rich and poor.

At a deeper level, the digital divide and the crisis of technological substitution are not caused by technology itself alone. They are closely related to the ownership of technology, the distribution of resources, and the structure of social relations. As a new form of productive force, digital technology could promote human development by saving labor time, expanding communication space, and improving the efficiency of public services. Yet under the domination of capital logic, technological advantages are often transformed into the competitive advantages of a few platforms and enterprises, while workers may be excluded from data income and technological benefits. Marx's analysis of machine industry is still enlightening: the machine itself shortens labor time, but its capitalist use may lengthen the working day. Digital technology has the same dual character. It contains the possibility of liberating labor, but it may also become a tool for extending labor, strengthening management, and producing inequality.

For this reason, the analysis of all-round human development in the digital era cannot remain at the surface of technological convenience or technological risk. It must further reveal the social relations behind technology. Whether digital technology can truly become a force promoting free and all-round human development depends on whether society can address the unequal distribution of technological benefits, the insufficient protection of labor rights, and the imbalance in the supply of public digital resources. Only when digital resources are transformed into common development opportunities can technology avoid becoming a new source of dependence and exclusion.

The crisis of technological substitution also needs to be understood dialectically. On the one hand, the replacement of repetitive, dangerous, and physically exhausting labor by machines can be a sign of social progress. It may release human beings from low-level and monotonous tasks and create conditions for more creative forms of labor. On the other hand, when substitution occurs without adequate social protection, training opportunities, and income distribution mechanisms, it may produce unemployment, anxiety, and new forms of exclusion. The contradiction is therefore not between human beings and machines in an abstract sense, but between the social use of machines and the developmental needs of human beings. If intelligent technology is used to save labor time for the whole society, it can support human liberation. If it is used to reduce labor costs while transferring risks to workers, it will intensify one-sided development.

For China, this issue is connected with the quality of modernization. A large labor force cannot be asked simply to adapt to technology without support. Workers need chances to change occupations, learn new skills, and share the gains created by technical upgrading. Local governments, enterprises, trade unions, schools, and communities can all take part in this process. If the transition is left only to the market, groups with weak bargaining power will face more risk. If society organizes training and protection in advance, technological substitution can become a push for better labor rather than a cause of exclusion.

The digital divide is not only a question of owning a device or being connected to a network. It also includes digital literacy, the ability to judge information, language resources, cultural capital, and the capacity to turn online tools into real opportunities. A person may have a smartphone but still be unable to find reliable information, protect personal data, use online public services, or take part in digital learning. Some people are technically connected but socially disadvantaged. Bridging the divide therefore requires public training, accessible interfaces, age-friendly services, community support, and a fairer supply of public digital resources.

Another difficulty is that the divide often appears after the first connection has been achieved. A village may have broadband, but students may still lack guidance on how to use academic resources. An older adult may have a health-code app, but may still be afraid of making mistakes when booking medical services. A small merchant may open an online store, but may not understand platform fees, traffic rules, or data tools. These cases show that access is only the first step. Digital inclusion must continue into use, understanding, protection, and benefit. Public policy should therefore measure not only the coverage of networks, but also the actual capacity of different groups to turn connection into development.

5. Guiding Technological Innovation through Marx's Theory of All-Round Human Development

Digital technology has made work and life more convenient in many respects, but it has also produced the dilemmas discussed above. This double effect is close to Marx's attitude toward science and technology under capitalist social relations. Marx did not simply reject technology. He saw that science and technology could raise productivity and create leisure time for people to inherit and enjoy the valuable achievements of culture, science, art, and social communication [12]. The question is how to free technology from alienated use and make it serve human development rather than domination.

5.1. Promoting the Construction of Social Relations through Technological Development

In the digital era, the construction of social relations should be placed at the center of technological development. Digital tools have indeed made contact easier. Messages, video meetings, online communities, and cross-regional cooperation allow people to connect beyond their local circles. People can work with others in different cities, join interest groups, and maintain family relations over distance. These changes may widen the social world of the individual and make cooperation more flexible.

Platform feedback also affects social relations. Posts, videos, comments, and creative works receive views, likes, collections, and replies. These numbers can give users a sense that their expression has been seen. They may also bring recognition and emotional support. But numeric feedback is not the same as real social value. When people depend too much on traffic data, they may begin to adjust expression to please algorithms or audiences. The social relation then becomes partly controlled by the platform's measurement system.

For this reason, data collection and traffic competition require limits. Platform regulation should include data rights, privacy protection, algorithmic transparency, and benefit distribution. Public digital platforms should also be strengthened, especially in education, health care, culture, and legal services. A platform should not become only a tool for traffic and control. It should help people build wider and more reasonable social relations.

Healthy digital interaction needs a normative order. Platform rules should discourage rumor, abuse, discrimination, and excessive emotional provocation. At the same time, they should protect reasonable disagreement and ordinary public discussion. If every online space is governed only by traffic, the result will be noisy communication with weak trust. A human-oriented platform order should support truthful expression, privacy, equal access, and cooperation. These elements allow digital communication to contribute to sociality rather than break it apart.

Digital technology can also support community building. Public service platforms, online consultation, digital cultural centers, and local governance apps may help residents solve problems and take part in community affairs. Rural areas and grassroots communities can use digital tools to connect with education, medical, cultural, and administrative resources. Yet such

tools should be designed for real users, including older adults and people with limited education. If the interface is difficult and support is absent, digital governance may exclude the very people it claims to serve.

The construction of social relations also requires a balance between online and offline life. Digital platforms can introduce people to one another, organize information, and reduce communication costs. But many relations still need face-to-face trust, shared work, and embodied cooperation. A community app may collect residents' suggestions, yet neighborhood negotiation often needs meetings and patient explanation. An online interest group may form quickly, but lasting cooperation usually depends on rules, responsibility, and repeated interaction. For this reason, technology should not be used to replace social work. It should reduce the burden of coordination and leave people more space to meet, discuss, and act together.

5.2. Establishing a People-Centered Direction of Technological Development

Guiding technology with the theory of all-round human development is a central task in the present period. Whether technology benefits or harms workers depends not on the device alone, but on social relations and value orientation. Marx wrote that capital is not a thing, but a social relation between people mediated by things [11]. Digital technology today is still shaped by capital logic. If this logic is left unchecked, data, algorithms, and platforms may deepen the digital divide, strengthen digital monopoly, and weaken workers' subject position.

A people-centered direction is therefore necessary. China should use institutional advantages to protect people's rights and to reduce polarization caused by technology. The distribution system based mainly on distribution according to work, together with multiple forms of distribution, needs to respond to new forms of digital labor. Workers who create data, maintain platforms, produce content, or provide services through apps should not be pushed outside the sharing of digital gains. The goal is not technology for its own sake, but technology that serves the people.

Institutional guarantees and strict governance are also needed. Data collection that tracks users excessively or violates privacy should be restrained. Rumor, fraud, and malicious manipulation on the Internet should be punished. Algorithmic management in employment should be made more transparent, especially when it affects work intensity, income, ranking, or dismissal. A clean and fair online environment does not emerge naturally. It requires law, public supervision, platform responsibility, and the participation of users and workers.

A people-centered approach also needs ethical assessment before new technologies or platform rules are widely used. Policy makers and enterprises should ask several plain questions. Will the system increase workers' burden? Will it reduce privacy? Will it exclude older adults or low-skilled users? Will it make public services easier to use or harder to access? Such questions are not outside technology. They are part of the social design of technology. Efficiency should be considered together with fairness, dignity, security, and human development.

The fair sharing of digital dividends is another key point. Data and platforms are produced through the participation of many users and workers, yet the gains often flow to a small number of enterprises. This pattern conflicts with the value of all-round human development. Society needs clearer rules on data rights, platform responsibility, and benefit sharing. Public resources created in the process of digitalization should return to education, training, health care, culture, and labor protection. Only then can digital progress become a common developmental resource rather than a private monopoly.

This question becomes more pressing as data become a basic resource of the digital economy. Users leave traces when they search, buy, travel, learn, and communicate. Workers also produce data in delivery routes, service ratings, content production, and online management. If all these traces are converted into private platform assets, the public contribution behind

digital wealth is hidden. A more reasonable arrangement should recognize that digital value is socially produced. This does not mean that every piece of data can be divided mechanically. It means that law and policy should prevent unlimited extraction and should return part of digital gains to public services, worker protection, and common digital infrastructure.

5.3. Attending to the Internal Needs of Workers

All-round development first requires the development of human individuality. Digital technology raises new demands for workers' knowledge, skills, and judgment. Education is therefore crucial. Science and technology education should be strengthened in primary schools, secondary schools, universities, and vocational training. Workers need to understand basic digital tools, data logic, information security, and the changing structure of occupations. Such knowledge helps them respond to technological change and improve their labor competitiveness.

Humanistic education is no less important. People must ask how technology should be used, what purposes it serves, and what kind of life it encourages. Without humanistic reflection, a person may become skilled in using tools but poor in value judgment. Marx's theory of all-round human development can guide this education by reminding people that technology is not an end. It should serve the fuller development of human beings. In this way, people can avoid both blind rejection of technology and passive dependence on technological convenience.

Workers' free time should also be protected as a basic condition of development. In the digital era, labor often appears as message replies, online meetings, platform orders, content maintenance, and data updates. These tasks may enter life time without being recognized as formal work. If rules are absent, work time can spread without limit. Labor protection should therefore clarify the boundaries of digital labor, remote labor, and platform labor. Rest, vacation, overtime recognition, offline rest, and algorithmic management should all be included in institutional design.

Free time is not idleness. It allows people to learn, communicate, appreciate art, create, exercise, care for family, and participate in public affairs. When institutions protect this time, the efficiency created by digital technology can become a condition for human development. Public cultural services and lifelong education systems should also help people use free time well. A worker who gains time but lacks resources for learning and culture may still find it difficult to develop. Time protection and public supply should therefore support each other.

All-round development in the digital era should not be reduced to technical skill. A worker may learn to use software and still remain trapped in narrow labor relations. Development also includes social relations, spiritual life, public participation, and the power to judge. If digitalization is used only to improve efficiency and strengthen competition, people may merely adapt to a technical system. The more valuable goal is to help people remain active subjects who can understand, question, and shape the digital environment around them.

Democratic participation is needed in the operation of technology. Digital platforms control algorithmic rules, data resources, and labor organization. If workers and consumers can only accept rating, dispatching, sorting, and evaluation, their subjectivity is limited. Governance should give workers, users, public institutions, and social organizations channels to participate in rule making and supervision. Algorithmic rules should be more transparent. Data rights should be clearer. Platform responsibility should be traceable. Technical order should also be an order that protects development rights.

The state and society should provide more digital support for vulnerable groups. Public training, community education, age-friendly transformation, and grassroots digital services can reduce gaps among regions, age groups, and occupations. When digital resources are fairly transformed into learning opportunities, work opportunities, and public participation, technology helps weaken old inequalities rather than strengthen them. This is one practical

route by which digital technology can support the development of abilities, social relations, and individuality.

Education in the digital era should combine technical competence with a humanistic orientation. Technical competence lets individuals use tools, understand data logic, protect information security, and adapt to new work. A humanistic orientation helps them ask what technology is for, how it changes relationships, and how moral judgment can be preserved in digital environments. Without technical competence, people may be excluded. Without humanistic orientation, they may become skilled but value-blind users. Schools, families, workplaces, and communities should all take part in this broader digital education.

Continuing education is especially important for workers. Digital transformation changes occupations, and many people need to update knowledge more than once in their working life. If training resources are available mainly to highly educated groups, the gap among workers will widen. Public policy should support lifelong learning, vocational retraining, mixed online and offline courses, and learning opportunities for middle-aged and older workers. Enterprises should help workers adapt to new tools instead of simply replacing them. Education is not only a market response; it also strengthens autonomy and widens life possibilities.

Continuing education should also avoid a narrow technicalism. Many training programs teach software operations but pay little attention to rights awareness, communication, ethics, and mental health. Yet workers who face platform rules need to know how to protect their rights; citizens who use public service apps need to know how to protect privacy; students who rely on search engines need to know how to evaluate sources. A richer form of digital education should combine skill, judgment, and civic responsibility. Such education may not produce immediate economic returns in every case, but it is closely related to the kind of person and society that digital transformation will shape.

5.4. Improving Digital Governance and Public Supply

Digital technology can serve all-round human development only when public governance provides stable support. First, digital infrastructure and public digital resources should be strengthened. Education, medical care, culture, legal services, and social services should be opened more widely to grassroots areas, vulnerable groups, and different age groups. The results of digitalization should not remain inside a few platforms or among high-skilled groups. They should become ordinary developmental opportunities.

Second, algorithmic governance, data rights, and platform responsibility need clearer rules. Workers should not remain passive in platform evaluation, traffic distribution, order allocation, and data use. When algorithms affect income, labor intensity, public service access, or information visibility, their rules should be open to supervision. Users should have channels for appeal and correction. Platforms should bear responsibility for the social effects of their systems.

Digital governance must balance efficiency with fairness, security, and freedom. Efficiency matters, but it can damage people if it becomes the only standard. A platform may deliver orders faster by pushing workers harder. A public service app may collect information more easily but also exclude older adults. A school platform may raise measurable performance while narrowing learning. Governance should look at these concrete effects. The question is not only whether a system works smoothly, but whether it supports a better human life.

Public supply also requires a clearer view of the public nature of certain digital resources. Basic data infrastructure, public education platforms, cultural databases, and digital health services should not be organized only by market logic. They carry public functions. Government, schools, communities, and social organizations should help build and maintain such resources. If public supply is strong, digital technology can reduce differences in development conditions. If public

supply is weak, digitalization may enlarge the gap between people who can buy services and those who cannot.

Accountability should run through the whole process of technological operation. Algorithms that influence employment, credit, education, public service, or cultural visibility should be traceable and subject to review. Data collection should follow clear rules of necessity and consent. Platform labor should be protected by standards on workload, income, safety, and rest. These measures may look technical, legal, and administrative at the same time, and that is precisely why they matter. Digital governance is not only about managing tools; it is about shaping the social conditions of human development.

Public governance also has to be patient. Digital systems change quickly, and a rule that works today may be insufficient tomorrow. Regulators need professional knowledge, but they also need channels to hear workers, teachers, parents, patients, older adults, and other ordinary users. These groups often notice problems before they become visible in official statistics. Complaints about confusing interfaces, unfair platform penalties, excessive messages, or opaque recommendations should be treated as information for governance. In this way, the public can take part in correcting the direction of technology. This participatory process is itself part of all-round human development, because people are not merely managed by systems; they help shape the systems that affect their lives.

The protection of free time should be placed in this governance framework as well. Public digital services should reduce unnecessary procedures, not move more administrative burdens onto individuals. Workplace platforms should simplify cooperation, not create endless reporting. Educational platforms should support learning, not turn study into continuous surveillance. These distinctions may seem small, but they determine how people actually experience digitalization. Good governance should repeatedly return to such ordinary scenes, because all-round human development is realized in daily life rather than only in policy language.

6. Conclusion

The digital era offers new chances for all-round human development, but it also creates new risks. Marx's theory reminds us to keep the measure of the human being at the center of technological change. Efficiency and fairness, tools and values, productivity and freedom should not be separated. Digital technology should serve human emancipation, not make people adapt endlessly to technical systems. When technical progress is joined with institutional reform and the reconstruction of social relations, the idea of an association of free individuals can gain more concrete meaning in the digital age.

More specifically, all-round human development in the digital era cannot mean technical ability alone. Nor can it be measured by the spread of platforms and intelligent devices. Marx emphasized the free unfolding of people in real social relations. Labor ability, communication, spiritual life, public participation, and individuality all belong to this process. A useful test is whether digitalization reduces one-sided labor, increases workers' free time, and allows more people to join knowledge production, cultural creation, and social governance. If it is used only for performance assessment, longer work time, and harsher competition, it moves away from that goal.

In the final analysis, the future of digital technology depends on social institutions and value orientation. Marx and Engels wrote in *The Communist Manifesto* that the free development of each is the condition for the free development of all [13]. This statement is still relevant. The digital era should release the positive role of new productive forces, but it must also protect labor rights, expand public cultural supply, strengthen digital literacy education, and govern platforms. Otherwise, technology may be monopolized and used in alienated forms.

The task is not to oppose technology, but to reshape the relation between technology and human beings. Digital tools should help people gain time, knowledge, health, social connection, and creative capacity. They should not turn people into isolated data points or permanently available workers. A human-centered view asks questions that a technology-centered view often ignores: who has access, who controls data, who shares the gains, who bears risk, and whether people become freer through the process.

Such a change requires more than moral appeal. It requires labor rules for digital work, public investment in digital resources, education that combines skill and judgment, and platform governance that accepts public responsibility. It also requires people to keep a critical attitude toward digital convenience. Convenience can support life, but it can also hide dependence. Only when individuals, institutions, and society act together can digital progress become a condition for human dignity and development.

Digital technology has a dual character. It can expand productive forces, enrich communication, and open fields for learning and creation. It can also compress free time, weaken subjectivity, enlarge inequality, and strengthen hidden domination. The decisive issue is not technology by itself, but the social relations and values that direct it. To adhere to Marx's theory of all-round human development is to judge digital transformation by whether it promotes the free, conscious, social, and creative development of real people. This standard should guide policy, education, labor organization, and cultural life in the digital era.

This standard also avoids two simple misunderstandings. One misunderstanding is technological optimism, which assumes that every new tool naturally brings emancipation. The other is technological pessimism, which sees only control and risk. Marx's theory allows a more careful judgment. It recognizes the productive power of science and technology, but it also asks how that power is organized and who controls its results. Digital technology may reduce toil, but it may also extend labor. It may open social space, but it may also produce isolation. The practical task is to push its first possibility forward and to restrain its second tendency through institutions, education, and public participation.

Future research may continue this discussion with concrete groups and industries. Platform delivery workers, teachers who use learning systems, elderly users of public service apps, and young people who grow up with recommendation algorithms do not experience digitalization in the same way. Their different experiences can show where technology supports development and where it creates new pressure. Such empirical attention would also prevent the theory from becoming too abstract. The present paper offers a theoretical discussion, but its basic orientation is practical: technology should be judged by what happens to real people's time, health, relations, judgment, and creative capacity. When these dimensions are protected, digital transformation can show its positive historical meaning.

For publication, this point also makes the paper's argument more modest. It does not claim that digital technology alone can bring all-round development, and it does not claim that technology must lead to alienation. It argues that the direction of digitalization depends on social design. Labor rules, education, public services, platform governance, and everyday habits all decide whether technology becomes a tool of development or a source of new dependence. This is why the Marxist concern with real social relations remains necessary in the digital age.

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