Management and Development for Research and Studies | Volume: 14 /N°: 02 December(2025), p 191-209

Re-engineering Cyber Marketing Mechanisms and Tools to Industry 4.0 Dynamics and Contexts (Digital Transformation in light of ICTs and CPSs)

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Received: 22/05/2025 Accepted: 18/09/2025 Published: 01/12/2025

Abstract:

This study addresses a topic of utmost importance, both now and in the future. Cyber Marketing mechanisms are in dire need of adapting to the requirements and conditions of the fourth generation of successive industrial revolutions. Industry 4.0, or the Fourth Industrial Revolution has imposed numerous constraints on Marketing & Sales professionals, on the one hand, while simultaneously providing many strategic gains that help marketers gain a Sustainable Competitive Advantage (SCA), on the other. Undoubtedly, it is imperative to adapt marketing tools and methods to Information and Communications Technologies (ICTs) and Cyber-Physical Systems (CPSs), which coincided with the birth of the fourth wave of the industrial revolution. These Emerging and Enabling Technologies include Artificial Intelligence (AI) solutions, Machine Learning (ML) algorithms, Big Data Analytics (BDA), and many others. The research papers concluded that Cyber Marketing Decision Automation is inevitable, as it is the optimal approach for exploiting opportunities, particularly Hyper-Personalization of Customer Experiences (CX), and avoiding threats, particularly ethical concerns and data privacy.

Keywords: Cyber Marketing; Industry 4.0; Information & Communications Technologies; Cyber-Physical Systems

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1. Introduction

In 2017, John Chambers, former CEO of Cisco Systems, stated that 40% of companies that do not adapt or respond to today's competitive digital game rules will be disrupted, declining, and disappearing within ten years, and that 70% of them will seek Digital Transformation, but only 30% will succeed.

Therefore, companies today face a difficult choice: either adapt effectively to keep pace in the cyber age, or remain stagnant, resist change, and adhere to traditional business models. Unsurprisingly, this bleak forecast and pessimistic statement are not the product of randomness, but rather the scientific words of an expert in the global technology market.

This new era is often referred to as the digital age. Undoubtedly, the implications of electronic information systems and technologies, wired and wireless communications, the Internet, intranets, extranets, and satellites are comprehensive and global, raising the concerns and interests of all stakeholders in the public and private sectors, as well as academia and civil society.

In addition to the implications of Artificial Intelligence (AI), Machine Learning (ML), Artificial Neural Networks (ANNs), Natural Language Processing (NLP), Large Language Models (LLMs), Big Data Analytics (BDA), Robotics, Augmented Reality (AR), Virtual Reality (VR), Internet of Things (IoT), Cloud Computing (CC), Quantum Computing (QC), 3D Printing (Additive Manufacturing), Blockchain (BC), 5G, 6G, Satellite Internet, Semantic Web (3.0), Symbiotic Web (4.0), etc.

All of the above are just examples, and there are many more. These changes, variables, circumstances, and conditions have not only left a profound impact on the economy, management, competition, trade, business, agriculture, industry, tourism, financial services, transportation, energy, and pharmaceuticals, but have also impacted several vital and dynamic non-profit sectors, such as health, education, culture, politics, society, urban planning, civil engineering, infrastructure, sports, and defense.

The entire world is currently experiencing the Fourth Industrial Revolution, supported by Information and Communications Technologies (ICTs) and Cyber-Physical Systems (CPSs) tools, which are relevant to the demands of Quality of Life (QoL), Sustainable Development Goals (SDGs), improved living standards, and sustainable wealth growth. Reports from specialized international organizations and bodies, in addition to statements from experts, scientists, and decision-makers in the field of E-economy, indicate that the outcomes and results of amazing scientific development and the tremendous and steady technological progress in operating systems, software, equipment, and audio-visual media will inevitably bring about qualitative leaps, shifts, and radical transformations at an accelerating pace in future marketing practices in all their details and ramifications:

- New Product Development (NPD).
- Smart Pricing (SMART).
- Integrated Marketing Communications (IMC).
- Supply Chain Management (SCM).
- Transportation Management Systems (TMS).
- Warehouse Management Systems (WMS).
- Customer Relationship Management (CRM).
- Customer Experience Management (CEM).

Here comes the question that arises with great urgency: How will Industry 4.0, or the Fourth Industrial Revolution enhanced by Information and Communication Technologies (ICTs) and Cyber-Physical Systems (CPSs), affect Online Sales activities and Cyber Marketing efforts?

2. Information and Communication Technologies (ICTs) and Internet ... Enablers and Enhancers for Marketing & Sales

Although there is no single, universally agreed-upon definition of ICT due to constant updates, improvements, innovations, creativity, inventions, and discoveries, the term ICT generally refers to all devices, network components, applications, and systems that collectively allow individuals, profit-making and non-profit organizations to interact and communicate in

these vast digital worlds and massive cyber environments. It is a diverse, rich, and integrated system of technical tools and resources used to produce, transmit, store, share, and exchange data and information.

It is important to understand the components of an ICT system, which include computers and the Internet (websites, blogs, email, and social media platforms), live broadcasting technologies (including decades-old technologies such as radio and television broadcasting, or newer technologies such as online broadcasting and digital television), recorded broadcasting technologies (audio broadcasting, audio and video players, and storage devices), telephony (landline phones, mobile smartphones, and tablets), satellites, video conferencing, and so on.

In addition, it contains a wide and constantly growing list of Digital Innovations and Disruptive Technologies such as Artificial Intelligence and Robotics, which are more recent entries in a world characterized by an abundance of information and fierce global competition.

If we were to list the most important pros of life and livelihood, the social and cultural advantages, and the economic and commercial benefits of ICT, we would be unable to do so, due to the magnitude and quality of the positives, both quantitatively and qualitatively. It enhances transactions, transportation, interactions, relationships, bonds and connections, and has created a revolution in the fullest sense of the word, as it has radically changed the way people work, communicate, learn, study, live, shop, consume, save, invest, travel, tourism, hospitality, treatment and medication... etc.

One of the most prominent examples of the added value that ICT has provided to humanity as a whole is that during the pandemic and the outbreak of the Coronavirus, and the paralysis that has afflicted various governmental and civil sectors, it has served as a lifeline, through the widespread shift towards supporting distance education and e-learning in the digital space instead of face-to-face and in-person study and teaching in close proximity. This is in addition to the spread of the culture of online training courses and remote medical and legal consultations, and the expansion of online shopping and the growing e-commerce, which has

become highly relied upon, depend upon, and bet on.

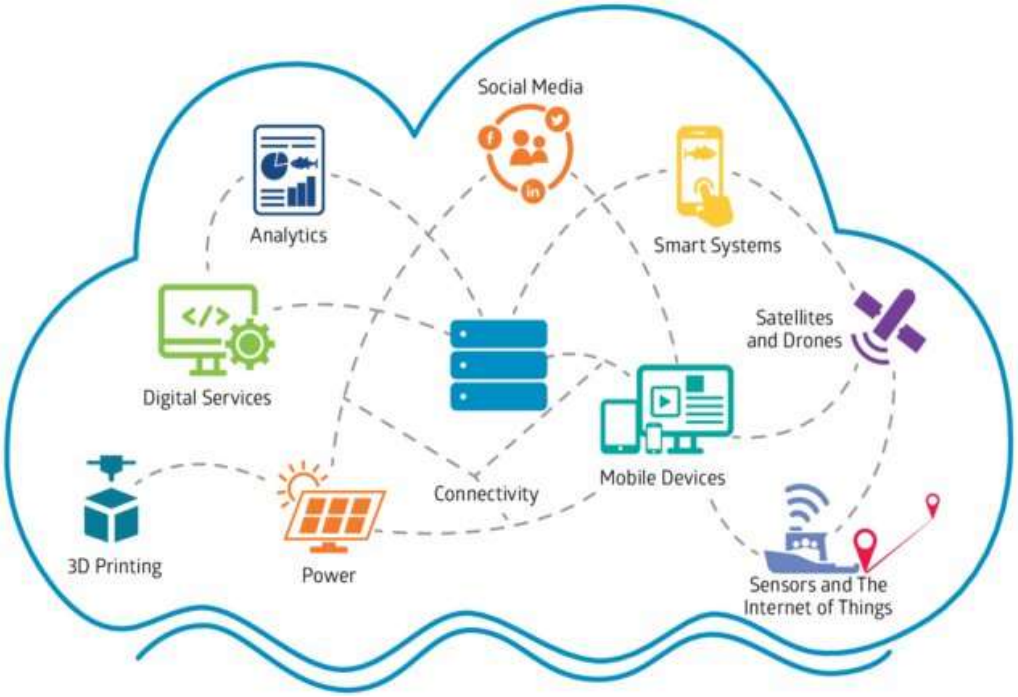
One of the most striking and interesting topics is the profitability and effectiveness of organizations and institutions' use of advanced ICT, the Big Data revolution, and automation. The importance of the latter is unanimous, both in terms of controlling cost behavior and reducing them to their lowest levels, and in terms of organizations' conversion of massive amounts of big data into wise decisions that benefit brand marketing strategies and achieve a Sustainable Competitive Advantage (SCA).

ICT has become a crucial requirement for job searches and interviews. Computer skills are a must for every job seeker. Today's professions offer a pressing need to master one of these fields: computer programming, information security, cloud services, website design and development, network engineering, big data analytics, machine learning and artificial intelligence, database management, software and systems development, etc.

However, the repercussions of ICT adaptation do not always offer purely positive opportunities and gains. They are subject to several criticisms and objections, given the problems and challenges they pose for governments, organizations, and individuals. What is meant here is cyber corruption and cybercrime, which are steadily expanding, despite the arsenal of laws, legislation, and regulations enacted by countries to limit these scourges, such as pyramid or network marketing, theft of funds and intellectual property, malicious cyber-attacks, hacking of bank accounts, or the disruption of systems that control vital infrastructure.

(See: Market-Prospects Team. 2022; UNESCO Team. 2017; School of Higher Commercial Studies of Paris. 2019; Siebel, T. M. 2017; Rouse, M. 2022; Pratt, M. K. 2019; Alexander, C. N., et al., 2015; Shah M. D., & Hoque, S. 2010; Behera, B. S., et al. 2015; Cuevas-Vargas, H., et al. 2021; Mastorakis, G., et al. 2015; Periša, M., et al. 2015; Buhalis, D., & Murphy, H. 2017; Al-Adamat, A. 2015; Yoo, K. H., & Gretzel, U. 2016; Arjang, A., et al. 2023).

Fig.1. Types of Information & Communication Technologies.



Source: Choudhury, A., & Tanzina, N. 2020

3. The Fourth Industrial Revolution ... A Momentum of Radical Transformations and a Surge of Dramatic Developments

Industry 4.0 is a qualitative leap with geometric progression and exponential speed. We are in the midst of a record pace and a profound transformation in the way we manufacture products thanks to Digital Transformation in the field of manufacturing. This smart present will pave the way for a future that will be smarter, and competition will no longer be in searching and exploring for energy sources, but rather in seizing and snatching intellectual, and mental capital, and attracting and kidnapping talented, creative and innovative people through material temptations and

moral incentives.

The fourth generation of the Industrial Revolution is the cumulative result of a long time series:

- Industry 1.0: Relying on mechanization through hydropower and steam.

- Industry 2.0: Relying on electricity in large production and assembly lines.

- Industry 3.0: Relying on computers and automation, enhanced by the intelligence of autonomous systems fueled by data.

Proponents of Industry 4.0 see it as a distinct and exceptional revolution, not simply an extension of previous revolutions, and the transformation that humanity as a whole is witnessing continues to unfold.

The fourth wave of the industrial revolution represents the beginning of an age of imagination. There is no doubt that the world is changing faster than ever before. Every day and night, we stand on the brink of computers and electronic revolutions.

The implications and contributions of smart information technology tools and digital communications networks, such as cyber-physical systems, artificial intelligence, advanced robotics, big data analysis, cloud computing, the Internet of Things, nanotechnology, etc., are radically and dramatically changing the way we live, work, and communicate with each other. They have played, in the past, are present, and will play, in the near and distant future, a prominent role in the areas of social, economic, and environmental development sustainability. They enhance competitiveness in the field of creativity and innovation by creating new industries and changing existing traditional industries. They transform the way, method, and mechanism by which things are produced, engineered, and designed, and support business growth, operational efficiency, and production flexibility in all industries are dramatically and widely influential.

The first to introduce the term IR (4.0) in scientific literature and practical applications was Klaus Schwab, founder and executive chairman of the World Economic Forum in Davos in 2015. We are now in the third decade of the 21st century, and there are great transformations, tremendous

developments, and rapid and terrifying changes in the characteristics of industrial capitalism, specifically in the transformation of the business models of industrial establishments, due to the increase in interconnection, integration, and continuous smart automation, in terms of the ability of machines, devices, sensors, and people to communicate with each other.

Perhaps one of the reasons for the exponential increase in the applications of innovative IR (4.0) technologies today, as a tributary to strategic intelligence to solve intractable problems and address complex dilemmas, is to rebuild the global economy sustainably in the wake of the COVID-19 pandemic. However, IR (4.0), at its core, is linked to the United Nations Sustainable Development Goals (SDGs) and the achievement of what is known as the well-being and prosperity of people and societies, known as quality of life.

Indeed, there is a connection between IR (4.0), the trend toward automation and data exchange in manufacturing and process technologies, and the dimensions of human development, namely livelihood, health, and education. This may apply to the economies of countries that have made advanced strides in Digital Transformation—developed nations, as well as emerging countries. However, for the Third World, which is lagging behind in science and research and lagging behind in technology, electronics, digitalization, and cyberspace—these are unattainable.

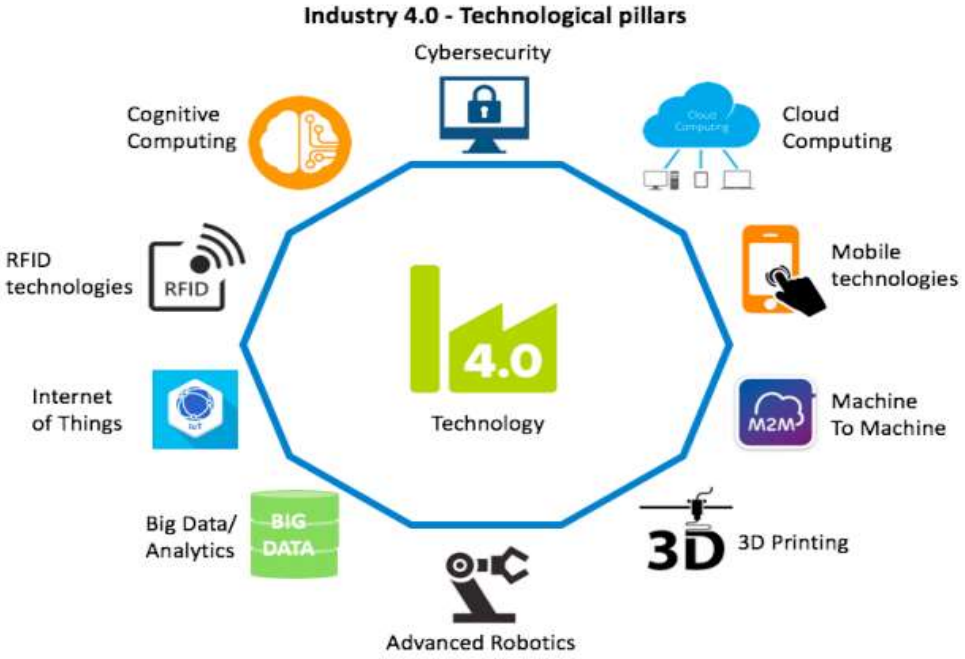
The laxity of some business organizations in adopting IR (4.0) applications and activating its tools, and neglecting to care for human resources specialized and trained in the use of Information and Communications Technologies (ICTs) and Cyber-Physical Systems (CPSs), will result in heavy consequences and costs, especially since global competition today is violent and intense, and the competitive advantage of dominance, exclusivity, control, influence and monopolizing the largest market shares is based on skill, ingenuity, cleverness and control of computer technologies and what revolves around it.

Especially now that business owners and senior executives have become convinced that improving strategic performance, growing wealth, and increasing return on investment depend on the presence of automated

sensors and programmed, networked robots that can collect, analyze, and interpret significant amounts and enormous volumes of data, information, and numbers, which humans are incapable of, or even impossible to accomplish, within a reasonable timeframe and with extreme accuracy.

(See: UK Gov Department for Business. 2019; Mario, R., et al. 2021; Marr, B. 2021; Chunguang, B., et al. 2020; Moore, M. 2019; Diedrichs, E., et al. 2017; Bonner, M. 2017; Schwab, K. 2015; Morrar, R., et al. 2017; Philbeck, T., & Davis, N. 2018; Koh, L., et al. 2019; Hassoun, A., et al. 2023; Martinelli, A., et al. 2021; Stăncioiu, A. 2017; Griffiths, F., & Ooi, M. 2018; Lu, Y. 2025; Singh, J., et al. 2025; Motallebi, S., et al. 2025).

Fig.2. Technologies used in the Fourth Wave of the Industrial Revolution



Source: Saturno, M., et al. 2017

4. Cyber Marketing Strategies and Policies Based on Fourth Industrial Revolution Technologies ... Structural Reforms and Qualitative Leaps

A Chief Marketing Officer (CMO) may claim to be an excellent Marketing Mix (MM or 4Ps), but the real test in the digital age is the Customer Experience Management (CEM) and the level of customer satisfaction with products and services, whether in physical stores or online. This is the quality of service provided to the target market. Marketing management of any organization will not become a role model unless it is able to meet the desires of existing and potential customers and meet their expectations compared to current and prospective competitors.

Companies wishing to compete in this rapidly evolving virtual environment may need to consider radical and structural changes. The challenge for marketers will not be what to do with the data they collect, but how to use it (quality, not quantity). You can have the most advanced technologies, but without marketing intelligence that unifies data insights, the technology will not deliver the ROI you expect. A fruitful partnership between marketing and technology is essential, especially with expectations of increased spending on Marketing Technology due to increased marketing budgets, especially AI-powered marketing tools.

IR (4.0) supported by ICTs & CPSs mechanisms has impacted every part of our lives. Artificial Intelligence, Internet of Things, and other digital innovations and disruptive technologies are new models that have transformed the traditional lifestyle into a High-Tech lifestyle. The impact has also extended to the marketing system. Marketing has changed significantly in recent times, especially in terms of spending efficiency and performance effectiveness, including the ability to access and analyze data in real time, eliminating the need to resort to external consulting firms and market research and study offices.

Today's database- and algorithm-driven Marketing Technology is capable of handling Big Data Analysis (BDA), creating a situation where improvements and adjustments can be made very quickly. This data also opens up a better understanding of Consumer Behavior (CB), so that companies can meet their needs and expectations through Hyper-Personalization powered by Machine Learning (ML), while also reducing operating costs by managing energy and resource usage, and by automating

routine tasks and repetitive processes.

The effects of IR (4.0) supported by ICTs & CPSs tools on the present and future of the Cyber Marketing industry are numerous and varied. We believe that the executive management of Marketing & Sales should be extremely careful about the issue of managing the smooth transition from offline marketing to online marketing or hybridizing, merging and blending them together, because the procedures and measures of Digital Transformation require specialized human resources with professional skills and high professional experience not only in the arts of Email Marketing, Social Media Marketing, Content Management Systems (CMS), Affiliate Marketing, Online Advertising, Influencer Marketing, Video Marketing, Mobile Marketing, Google Ads, PPC, Web Marketing, E-commerce, Search Engine Marketing (SEM) and Search Engine Optimization (SEO), but also even skilled control of computer science and internet and web technologies.

Marketing, business, and technology will continue to change in the future, and some organizations may need to address structural organizational reengineering issues to fight for survival and sustainability, and to stay afloat in the face of fierce global competition. This should also take into account the digital divide between developed countries with rich capabilities and resources, and access to high-speed internet. And developing countries with modest and fragile digital and electronic infrastructure.

There is no doubt that in today's world, technology has become a useful, vital, and widespread E- marketing tool in successful organizations. It has become difficult, if not impossible, to imagine an organization without it. Therefore, its use and integration are essential for companies to succeed in their marketing efforts. It has had a profound impact on the marketing industry in general, and digital marketing in particular, through the use of numerous tools and platforms to promote products and services, interact with customers, and analyze market data. ICT & CPS-driven digital marketing has revolutionized traditional marketing methods for about a decade.

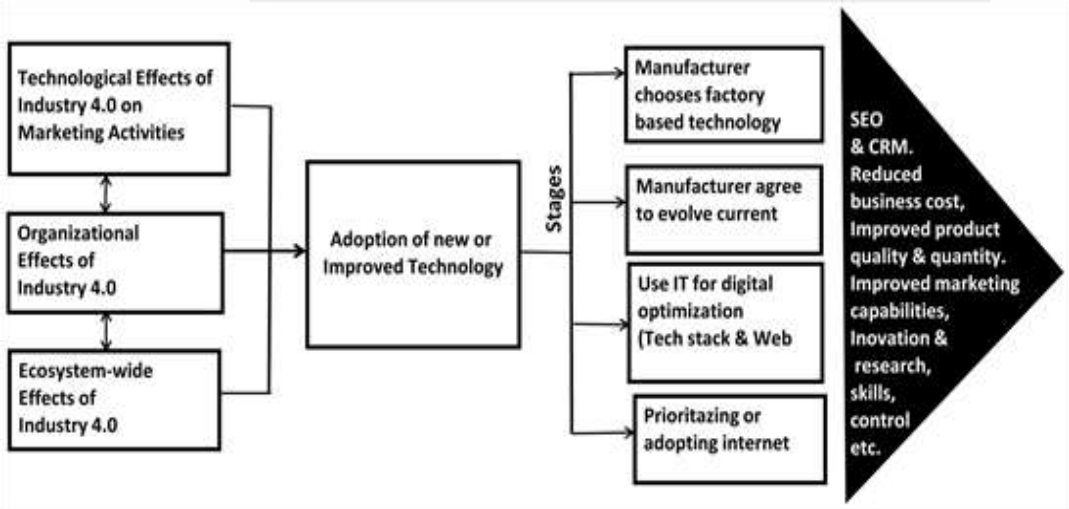
With the advent and birth of IR (4.0) supported by ICTs & CPSs tools,

tactical marketing known as the enhanced marketing mix has witnessed a massive transformation like never before. It has opened a wide range of opportunities and sales gains for brands to integrate and respond to customer needs in real-time (Real-Time Marketing), targeting customers with the right promotional message, the right communication medium, at the right place, and at a dynamic price.

The fourth generation of the industrial revolution is a gold mine of information for smart marketers, who will inevitably win the Cyber Marketing game by securing more customers and, ultimately, making money. Industry 4.0 mechanisms and innovative technologies play an increasingly important and significant role in scrutinizing, diagnosing, tracking, monitoring, and detecting consumer patterns, habits, and behaviors in real time, all of which are crucial for making critical Cyber Marketing decisions.

(See: BBC Team. 2023; Jakhar, V. 2023; Kotler, P., et al. 2021; Wigmore, E. 2021; Zhu, Z. 2021; Lysak, A. 2020; Singh, S. 2020; Hannay, F. 2019; Kotler, P., et al. 2016; Ungerman, O., et al. 2018; Guven, H. 2020; Nosalska, K., & Mazurek, G. 2019; Rosário, A. T., & Dias, J. C. 2022; Bettiol, M., et al. 2017; Sterev, N. 2017; Shkurupskaya, I. O., & Litovchenko, I. L. 2016; Raj, R., et al. 2024).

Fig.3. The Impacts of Industry 4.0 on Marketing Activities and Strategies



Source: Komakech, A. O., et al. 2021

5. Conclusion

Technology changes with the times and is constantly evolving. Governments, companies, and even individuals increasingly rely on the tools and mechanisms of Information and Communications Technologies (ICTs) and Cyber-Physical Systems (CPSs) to manage their affairs, run their businesses, and grow their wealth efficiently and effectively. Adapting and adjusting to these conditions and developments has become an inevitable, existential, and fateful necessity, indeed a matter of life or death, more than ever before, and irreversibly.

In the age of science fiction (Metaverse), a world characterized by abundant information, fierce competition, and the computer and cyber revolution, marketing systems supported by disruptive technologies and digital innovations have become more vital and dynamic. They have provided strong momentum, tremendous impetus, and enormous opportunities for organizations to meet the need for growth and expansion in national and global markets.

With the continued advancement of science and technology, the world of marketing is changing at an exponential rate. The fate of traditional

marketing in the physical environment is at stake. The technological boom in the age of Algorithmic Intelligence has rendered old marketing methods and activities ineffective, unable to withstand the passage of time and on the verge of extinction.

The Fourth Industrial Revolution is the result of a gradual cumulative series of previous revolutions. It is the name given to current industrial practices using the latest smart digital technologies, which focus on automation and data exchange in modern manufacturing techniques and new business models. These include Cyber-Physical Systems, Artificial Intelligence, Internet of Things, Cloud Computing, etc. There is no doubt that IR (4.0) supported by ICTs & CPSs plays an increasingly important and significant role in the Quality of Life of people and societies and in achieving Sustainability Goals.

Change is the only constant in the competitive game. On the one hand, marketing variables must proactively align with ICTs & CPSs requirements, otherwise competition is merciless and only the fittest will survive. Accordingly, Cyber Marketing & Sales departments are in dire need of more agile organizational approaches. On the other hand, the marketing domains impacted by Industry 4.0's enablers and enhancers are expanding, so those who adapt to this change will prevail, while those who refuse change and cling to the status quo will inevitably fall behind.

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