

The ICT-related SDG indicators: Prerequisites, progress, and interpretation

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Abstract: Despite the efforts of public institutions and government spending, progress on the SDGs is mixed at the midpoint of the 2030 timeframe—some targets are off track and some have even regressed. ICT-related indicators, on the other hand, stand out for their strong progress. The author notes this progress, but questions its relationship to the implementation of the 2030 Agenda. He argues that the growth in internet and mobile network penetration is due to the economic characteristics of communications development. The objectives of the article are to review the impact of the ICT sector on economic growth, to consider the role of government spending in the development of this sector in the context of fostering the achievement of the Sustainable Development Goals, and to identify the prerequisites for significant progress towards SDG targets in communications. Achievement of these objectives will make it possible to determine whether this progress is a consequence of targeted efforts to achieve the SDGs, or whether, in accordance with the author’s hypothesis, it is based on the specifics of the ICT sector’s development, allowing for the accelerated spread of mobile communications and the Internet, which is reflected in the SDG indicators.

Keywords: sustainable development goals; ICT; Internet and mobile network penetration; SDG indicators; government spending

1. Introduction

Sustainable development goals are set “to ensure that all human beings can enjoy prosperous and fulfilling lives and that economic, social, and technological progress” (UN, 2015, p. 2) assume a high role of economic factors in ensuring this progress. In turn, inclusive and sustainable economic growth, which is one of the foundations of sustainable development in the 2030 Agenda for Sustainable Development, is due to the use of technological advances, including in the field of digitalization. The processes of digitalization of the economy and, in particular, the development and spread of the Internet, are recognized as one of the factors of economic growth in recent decades. Choi and Yi (2009) found evidence that the Internet plays a positive and significant role in economic growth, Qiang et al. (2009) concludes that a 10 percentage point increase in fixed broadband penetration would increase GDP growth by 1.21% in developed economies and 1.38% in developing ones, Manyika and Roxburgh (2011) noted that the Internet constitutes 3.4 percent of GDP in large and developed economies, Czernich et al. (2009) finds that GDP per capita growth is 2.7 to 3.9 percent higher after the introduction of broadband, Gholizadeh et al. (2014) found that there was a positive and significant association between internet use and GDP in ASEAN countries and so on. It also revealed the positive impact on the economic growth of certain aspects of digitalization—the development of the ICT sector (Bahrini and Qaffas, 2019; Hofman et al., 2016; Vu, 2011), the broadband Internet penetration (Alderete, 2017), the intensification of innovation activity

(Afonasova et al., 2019; Pan et al., 2022), mobile phone spreading (Aker and Isaac, 2010; Ward and Zheng, 2016), promotion of rural household savings and entrepreneurship (Zeng et al., 2023), enhancing competitiveness (Dabbous et al., 2023) fostering economic growth in countries along the “Belt and Road” (Zhang et al., 2022). Thus, it can be concluded that digital transformation has a positive impact on economic growth, which, in turn, contributes to SDG progress.

The importance of many aspects of digitalization is reflected in the 2030 Agenda for Sustainable Development, which notes that “the spread of information and communications technology and global interconnectedness has great potential to accelerate human progress” (UN, 2015, p. 5). The importance of ICT is reflected in several sustainable development goals and targets, in particular, in Goal 4. Quality education (4.b¹), Goal 5. Gender equality (5.b (Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women)), Goal 9. Industry, innovation and infrastructure (9.c (Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020)), Goal 17. Partnership for the goals (17.8²), and progress in the field of ICT and digitalization is measured by some SDG indicators. Mobile communication issues are represented by indicators 5.b.1 (Proportion of individuals who own a mobile telephone) and 9.c.1 (Proportion of population covered by the mobile network), the spread of the Internet and its accessibility are indicators 4.a.1 (Proportion of schools with access to the Internet for pedagogical purposes), 17.6.1 (Fixed broadband subscriptions per 100 inhabitants), 17.8.1 (Proportion of individuals using the Internet).

The public sector and government, in particular, play a significant role in the development of digitalization processes and related areas, including the ICT sector. This role is determined by several ways of influencing ICT and digital economy sectors, including government financing to stimulate the development of digitalization, state participation in the capital of ICT sector companies (especially in developing economies), regulation of the activities of digital industry enterprises through the formation of a legal framework or operational supervision, which is carried out both by special government agencies such as the Federal Communications Commission in the USA (Mezistrano, 2024), and by higher-level government institutions, up to parliament (for example, within the framework of congressional investigations (CRG, 2024)). Thus, the public sector entities are directly and indirectly involved in building a sustainable ICT sector and economy.

Currently, there is a consensus that government policy should be aimed at stimulating digitalization, the development of the Internet and communications, as well as the proper regulation of new digital technologies. Schearer (1999) states that the government has also been responsible for the development and evolution of the Internet, Vishnevsky et al. (2022) point out the need to use taxation for the fostering of a digital economy, Reynolds (2009) notes that the role of governments in the OECD has been to increasingly support investment in the communication sector. Many studies have also noted the need for government influence on the development of particular aspects of digitalization. Lee (2019) pointed out that governments should play a crucial role in fostering innovation to realize the great impact of the Internet of

Things, Chen (2021) noted the role of government in the digital transformation of business, Gasco-Hernandez et al. (2022) finds how local governments achieve digital transformation, Eskindarov et al. (2019) noted that regulation of the cryptocurrency market should reflect a clear pragmatic position.

2. Public budgeting on ICT in the context of sustainable development issues

Among the governmental tools to support digitalization, along with indirect incentives, direct budget financing is also used, including those carried out within the framework of special development programs e-government, ICT, broadband Internet access, next-generation mobile networks, and other digitalization goals. Sometimes such funding is allocated within the framework of special development programs, such as the Broadband Equity Access and Deployment Program in the USA, sometimes the goals of ICT and digital economy development are part of more general programs—for example, in Italy the pillar related to digitalization is one of six pillars in the National Plan for Recovery and Resilience (Giannini et al., 2023). Budgetary funding to support ICT development has been increasing strongly in many countries over the past decades, and in many cases, it has been growing faster than total government expenditures. We analyzed government expenditures on communication over the period 2005–2020 for 34 countries in different regions of the world, based on UNCTAD data, and found that in 22 of them, budgetary funding on communication increased over this period (**Figure 1**). Moreover, in 16 countries it increased more than total government expenditures. This indicates significant attention to the financing of communication development and, in almost half of cases, the priority of this sphere in the budgetary process.

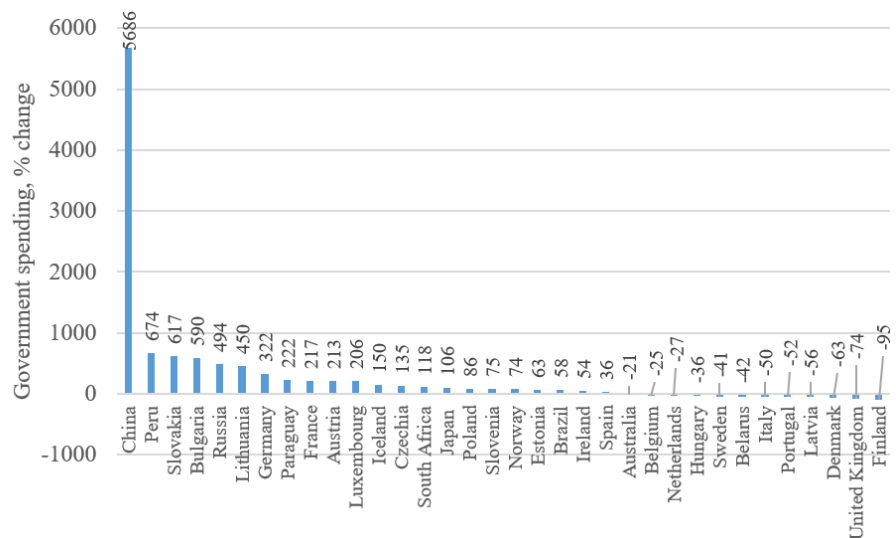


Figure 1. Change in government spending on communication in 2005–2020, % (UNCTADStat Data Centre, 2023).

The outpacing growth in government spending on communications in many countries is related to the creation of infrastructure and other conditions to provide access to broadband internet and modern mobile networks (4G, 5G) in rural areas as well as in educational institutions. These objectives are directly in line with the SDG

targets of overcoming inequalities (5.b.1, 8.10.2), innovation and infrastructure development (9.c.1, 17.6.1, 17.8.1). Thus, government spending on communication is in the context of achieving the Sustainable Development Goals, and its faster growth rate can be seen as an indication of the countries' commitment to accelerate the achievement of the relevant targets. At the same time, it should be noted that both the volume and share of communications spending in government spending are quite small. For the 34 countries in this sample in 2020, their total volume was \$26 billion (maximum in China, \$12.3 billion, minimum in Finland, \$3 million). The share of communication spending ranged from 0.002 per cent (Finland) to 0.47 per cent (Russia).

Obviously, there are various reasons for both the low share of communications expenditure and its decline, ranging from a difficult situation with public finances to a sufficiently high level of digital transformation that does not require a high level of public funding. For example, Finland, which has the lowest share of communication expenditures in the sample and the strongest decline in the volume of these expenditures, has very high levels of SDG indicators for mobile and internet development and obviously has no need to increase them, so it does not increase public funding for communications. On the contrary, countries with high dynamics of public expenditures on communications often do not have very good SDG indicators in this area, which predetermines the need for increased funding. However, these features are not a pattern; on the contrary, there are countries that have very high SDG indicators in communications but continue to actively finance this area. For example, in China, fixed internet broadband subscriptions per 100 inhabitants are 37.6 in 2021, even more than in Finland (33.7) (UN, 2024) and more than double the world rate (16.8), but China continues to actively fund communications, unlike Finland.

3. Sustainable development targets in communications-progress in dynamics and inclusion

The reduction of government expenditures on communications in the context of achieving the SDGs can also be linked to the high levels of corresponding targets. The SDG indicators related to digitalization and ICT are making maximum advancement, as noted in the latest reports on SDG progress: “mobile broadband (3G or above) access is available to 95 per cent of the world's population” (UN, 2023, p. 17), “in 2022, an estimated 66 per cent of the world's population (5.3 billion) used the Internet, fixed-broadband subscriptions continue to grow steadily” (UN, 2023, p. 25). A more accurate assessment of progress towards ICT-related targets can be made based on changes in several SDG indicators available in the UN SDG Indicators Database.

The SDG progress in IT and communications at the global and regional level is reflected in four main indicators—5.b.1, 9.c.1, 17.6.1 and 17.8.1. One more indicator—4.a.1 (Proportion of schools with access to the internet for pedagogical purposes) has large data lacunas in many regions, so it cannot be used for proper analysis. Looking at the four indicators, their change between 2015 and 2022 allows us to assess progress towards the targets in two dimensions-increasing the availability of mobile networks and the internet globally, and reducing inequalities in their availability between individual regions of the world.

The increase in global modern communications coverage, as reflected by the four SDG indicators, has been intense between 2015 and 2022 (**Figure 2**). Fixed broadband subscriptions per 100 inhabitants grew by 54.4%, the proportion of individuals using the Internet grew by 65.8%, the proportion of population covered by at least a 4G mobile network grew by 102.1%, and the proportion of individuals who own a mobile phone grew by 9.2% from 2019 to 2022. These are very high growth rates, far outpacing other SDG indicators.

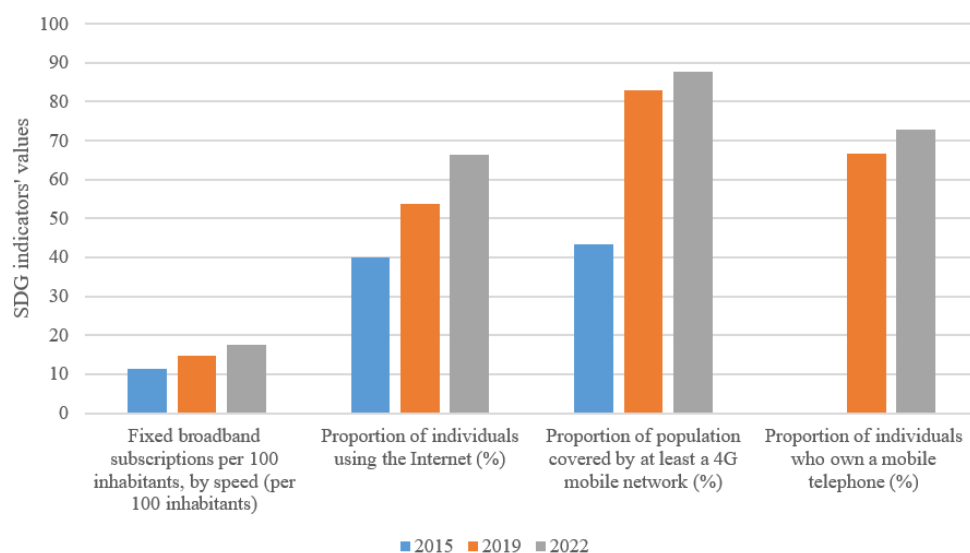


Figure 2. Progress of key global SDG indicators for internet and mobile networks (UN, 2024).

Table 1. The change in the difference of SDG indicators over the Internet and mobile networks in the regional dimension, times (UN, 2024).

	2015	2019	2022	Regions
The difference between the world indicator and the region with the worst indicator				
Proportion of individuals who own a mobile telephone (%)		1.4	1.2	Central and Southern Asia
Proportion of population covered by at least a 4G mobile network (%)	14.5	11	2.6	Middle Africa
Fixed broadband subscriptions per 100 inhabitants	114	49	35.2	Middle Africa
Proportion of individuals using the Internet (%)	4	2.4	2.1	Middle Africa
The difference between the indicators of the best and worst regions				
Proportion of individuals who own a mobile telephone (%)		2.1	1.7	Australia and New Zealand/Central and Southern Asia
Proportion of population covered by at least a 4G mobile network (%)	33.1	13.3	2.9	Northern America/Middle Africa
Fixed broadband subscriptions per 100 inhabitants	320	116	75.6	Northern America/Middle Africa
Proportion of individuals using the Internet (%)	8.5	4.2	3.1	Australia and New Zealand/Middle Africa

The four indicators also show significant progress in reducing disparities in access to communication technology between different regions of the world. This process can be assessed by comparing the differences between the values of these indicators for the world and for the least developed regions, as well as for the least and most developed regions. The values of these gaps for the four indicators and their change between 2015 and 2022 are summarised in **Table 1**. They show a significant

narrowing of the difference between the regions with the lowest internet and mobile network penetration rates and the world average and the most prosperous regions. The most pronounced progress in this case is observed in the penetration of 4G mobile networks and fixed broadband subscriptions.

The rapid narrowing of the gap in the availability of communication services can be considered evidence of progress in the field of digital inequality and, thus, the growth of inclusivity, which is one of the basic principles of sustainable development. The 2030 Agenda for Sustainable Development proclaims that “no one will be left behind” and “the Goals and targets met for all nations and peoples” (UN, 2015, p. 3), including ICT-related targets. The Agenda also states that “Sustainable development recognizes that ... combatting inequality within and among countries, creating sustained, inclusive and sustainable economic growth ... are linked to each other and are interdependent” (UN, 2015, p. 4), i.e., explicitly links disparities among countries to inclusiveness and inclusive economic growth. In this sense, the equalization of the level of Internet and mobile accessibility that occurred in the period 2015–2022 can be considered a brilliant example of the successful implementation of the policy of inclusivity pursued by the United Nations within the framework of the 2020 Agenda, in which the word “inclusive” sounds 39 times. Or maybe it still can't?

4. Progress of SDG targets in communications-inclusion, illusion, or delusion?

Is it possible that the brilliant indicators of progress on SDG targets in communications discussed above are not only an excellent example of approaching the 2030 Agenda's goals of inclusion, but also a challenge for communication on SDGs due to the specificity of digitalization? Why is there even a question about the illusion of progress in this case? Because overall progress on SDGs at the midpoint on the way to 2030 is very doubtful: “preliminary assessment of the roughly 140 targets for which data is available shows that only about 12 per cent are on track; more than half, although showing some progress, are moderately or severely off track; and some 30 per cent have either seen no movement or regressed below the 2015 baseline” (UN, 2023, p. 2). Communications related SDG indicators are among the “on track 12 per cent” SDG indicators, but is it possible that perfect performance is only occurring in one area, while many other indicators (non-ICT related) for targets 5, 9, 17 show no progress, off track or even regressed? It is obvious that SDG indicators related to ICT have certain features that determine their progress in isolation from other indicators of Gender equality (Goal 5), Industry, innovation and infrastructure (Goal 9), and Partnerships for the goals (Goal 17).

In our opinion, these features, which form the specifics of digitalization, consist in the very rapid technical and economic development of ICT, significantly outstripping other areas. The rapid development of technologies of broadband Internet and new generations of mobile networks, as well as mobile phones, also makes it possible to reduce the prices of services (**Figure 3**), which makes them more accessible to low-income users and rapidly increases the coverage of these technologies. This is happening both globally and regionally, including in the least advantaged regions of the world, where the decline in the price of ICT services is even faster. But this

technological driver of accelerated ICT development is not a product of the United Nations efforts on the 2030 Agenda, and therefore counting progress against the relevant SDG indicators is an illusion.

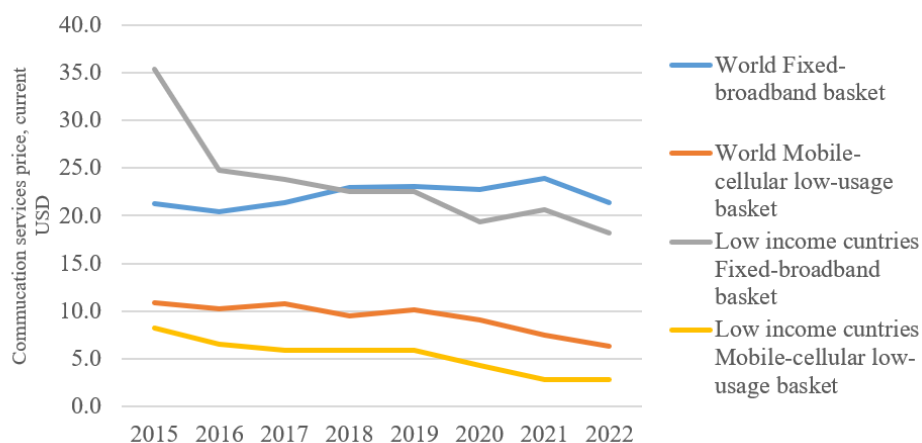


Figure 3. Dynamics of basic communication services price in the world and low-income countries in 2015–2022, current USD (ITU, 2023).

Another illusion, or even delusion, is the role of SDG actions in reducing ICT inequalities between rich and poor regions of the world. The ongoing narrowing of the gap in mobile and internet coverage is also linked to the technical and economic features of ICT and the declining prices of the related services. International Telecommunication Union data show that prices for baskets of basic communication services in low-income countries declined faster than in the world between 2015 and 2022 (**Table 2**). While in the world this price reduction was measured at 30–40 per cent, in the low-income countries it was two to three times. Price leveling of these services in some regions of the world has made a major contribution to narrowing the gap between poor and rich regions in terms of the proportion of individuals who own a mobile phone, the proportion of population covered by mobile networks, fixed broadband subscriptions, and proportion of individuals using the Internet. However, improving the affordability of digital services is not linked to work on the SDGs and measures of the 2030 Agenda, which have been insufficient in scope and have shown little progress or even regression. The total official development assistance for technical cooperation (indicator 17.9.1), for example, increased by only 12.8 per cent over 2015–2021 to \$35 billion for the world. Total official flows for infrastructure (indicator 9.a.1) totaled \$57.1 billion in 2021, down from \$60.5 billion in 2015 (UN, 2024) (down 6 per cent). In other words, the actions of the United Nations to achieve the SDGs in terms of financial assistance for infrastructure development could not have an impact (due to its insignificance) on the availability of Internet and mobile communications for less developed countries and regions. And the reduction in technical assistance for infrastructure development that has occurred inevitably leads to the conclusion that the impact of the SDG targets on the progress of the relevant indicators, both in terms of growth and in terms of reducing inequality, is a delusion.

Table 2. Price changes for ITU communication services baskets in the world and low-income countries in 2015–2022, % change (ITU, 2023).

	2022/2015	2022/2018
World		
Fixed-broadband basket	0.5	-
Data-only mobile-broadband basket	-38.4	-
Mobile-cellular low-usage basket	-42.4	-
Mobile data and voice low-consumption basket	-	-33.7
Mobile data and voice high-consumption basket	-	-43.2
Low-income countries		
Fixed-broadband basket	-48.7	-
Data-only mobile-broadband basket	-58.0	-
Mobile-cellular low-usage basket	-66.3	-
Mobile data and voice low-consumption basket	-	-57.7
Mobile data and voice high-consumption basket	-	-59.1

5. Discussion and future research agenda

The progress of sustainable development goals (SDG) depends, among other things, on government efforts through public expenditure. To provide clear guidelines for creating the necessary regulatory, economic and legal conditions for sustainable growth, public sector organisations need to have more relevant directions and indicators to stimulate growth. Meanwhile, not all SDG indicators correctly reflect the current SDG achievement situation. One example of this is the indicator related to information and communication technology (ICT). The practical contribution of this work is that it can lead to a better understanding of the progress of mobile networks and Internet penetration in the context of the Sustainable Development Goals, and the accuracy of their reflection in SDG indicators. The theoretical contribution of this work is that it negates the relationship between progress towards some SDGs (in particular the ICT-related SDGs) and declared efforts in this direction, including public spending on communications.

These are the preliminary and most general conclusions that create a foundation for future research on this problem based on a deeper analysis. If this hypothesis is confirmed in the course of further research, this may have a certain impact on the study of a number of problems in the field of sustainable development, as well as on the practice of developing policies in this area and programs that will replace the 2030 Agenda. In particular, it may be useful to pay more attention to taking into account industry specifics when developing future indicators for achieving sustainable development goals and targets.

This work certainly had serious limitations in terms of data availability (especially data on SDG indicators in terms of the duration of their time horizon, which was limited to seven years, from 2015 to 2022), completeness, representativeness of the countries in the sample, many of which lack the necessary statistics, and the resulting limitations in the use of quantitative analysis methods. The author believes that as data accumulate and national statistical databases develop in individual

countries, these gaps will be closed, making future studies more relevant and complete. At the same time, the results obtained in this article, despite their preliminary nature, reasonably demonstrate the problem of insufficiently correct assessment of progress in achieving SDGs when measuring it in different spheres, using ICT as an example, and thus show the prospects for further research. In our view, future research areas include the impact of public expenditure on SDG achievement, comparative analysis of SDG progress in different spheres aimed at identifying specific factors accelerating or inhibiting this progress, and the impact of ICT and digitalisation on sustainability and inclusiveness of development.

6. Conclusion

The example of the development of communications and the corresponding SDG indicators demonstrates the possibility of distorting the picture of progress in SDG targets due to the technological, economic, or other specifics of individual areas. This specificity is especially great in the sectors of the digital economy, where the pace of development is many times faster than most other areas featured in the SDG (for example, progress in the development of AI is incomparable with such inertial indicators as GDP, mortality rate, unemployment rate, and many others). The uneven development of individual spheres and progress in their SDG indicators makes it difficult to assess progress towards the Sustainable Development Goals in general, creating in some cases the illusion of success or, on the contrary, giving the impression that problems are insoluble due to insufficiently selected indicators. This illusion, in turn, can distort the direction of efforts of the public sector dealing with sustainable development, as well as the directions of financial flows of public budgeting to stimulate progress on SDG. To provide clear guidelines for developing the necessary regulatory, economic, and legal conditions for sustainable growth, fostering and budgeting public sector entities should have more relevant directions and indicators.

At the current stage of the implementation of the 2030 Agenda, it is obviously no longer possible to adjust SDG indicators in order to reduce such distortions. But in the future, at the next stage of the movement of the United Nations towards sustainable development beyond 2030, new goals, objectives, and indicators should take into account the specifics of individual areas, especially those related to digital transformation, and their impact on the fundamental goals of justice, equality, overcoming poverty and development so that these goals are not eclipsed by technological development, and the progress of digitalization did not create illusions.

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Notes

¹ By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including

vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries.

- ² Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology.

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