



THE NEW WORLD OF INFORMATION AND COMMUNICATION TECHNOLOGIES: GLOBAL AND REGIONAL TRENDS

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Abstract *The main objective of this paper is to identify the recent global and regional trends in ICT developments and to reveal how companies improve productivity and modernize production and services. Nowadays, the digital lifestyle of the consumers forces technology companies to address their needs in order to maintain and extend the market share. In the 21st Century, wearable devices and other forms of digital applications are gaining momentum. More users are interested in buying notebooks, smart TVs, tablets, smartphones, fitness products, smart watches, connected eyeglasses in order to be in the latest fashion of 21st Century or to use them to make the difference in the competitive markets. The Internet of Things, Unified Communications and 3D printing will revolutionize our lives in the years to come.*

Key words:

Broadband,
wireless, mobile,
cloud, ICTs

JEL Codes:

L63, L 96, M 15,
O14

1. Introduction

Information and Communications Technologies (ICT) refer to means and methods human society has developed along the time in order to facilitate long distance personal and businesses communications. ICT, in particular broadband Internet, are revolutionizing the business environment, public service delivery, knowledge and innovation transfers. Information and Communications Technologies were subject to various analyses which proved the importance of their tools to the development of economy and human welfare.

Using data collected from 367 large companies, (Brynjolfsson and Hitt, 1994:11) estimated that a 1% increase in spending on computer capital is associated with a 0.0126% increase in output, when all the other input is held constant. Because computer capital accounted for an average of 2.18% of the value of output each year, this implies a gross ROI (increase in dollar output per dollar of capital stock) for computer capital of approximately 58% per year, holding other inputs constant. For the full sample which also included non-manufacturing firms, the output elasticity of computer capital was estimated at 0.0169, implying an average ROI of 81%. (Jorgenson and Stiroh, 1995: 295-316) found that from the end of the 1970s to mid 1980s, ICT devices caused an output growth of 0.52% per year, and from 1985 to early 1990s, the contribution was 0.38% per year.

ICT have become indispensable tools for the daily operations of individuals and companies. Premkumar, (2013) said that ICT infrastructure itself can be made greener with virtualization, Cloud and smaller form factors. ICT can be a key enabler for communication and information dissemination among large groups. It is also an enabler to measure, track, manage and report environmental performanceⁱ. Melville *et al.* (2004: 2) underline the fact that investing in ICT adds value to firms, but the impact of this kind of investment depends on complementary resources, competition and macroeconomic environment. Holt and Jamison (2009: 10-11) suggested that broadband has had a positive economic impact overall, but the quantitative impact could not be measured with great precision.

The expansion of mobile Internet connectivity has helped buoy the ICT sector during the crisis, with 6% growth a year in revenue between 2000 and 2011 for the top firms. ICT services are doing better than ICT manufacturing, reaching output growth of 5%-10% in 2012. Employment in the sector has benefited too, with the top firms hiring more than 14 million people worldwide in 2011, a 6% increase from 2010. Among the top ICT firms, Internet firms performed the best in terms of revenue and employment growthⁱⁱ.

Flanagan (2012: xiii) says VoIP (voice over IP) and UC (unified communication) may reduce overall costs in the long term, but it/imply additional costs. Nemertes Research interviewed hundreds of companies that

deployed VoIP to find the average first-year expense; it was over \$1400 per employee. UC features would be additional.

The Internet of Things (IoT), or the Internet of Objects (IoO), will change the life as we know it. IoT referring to objects as: cars, kitchen appliances, smartphones, smart watches and health devices which are interconnected on the Internet.

The authors of “Redefining the digital divide”, (the digital divide refers to the unequal ability to access and use ICT) a survey from The Economist Intelligence Unit, concluded that “significant progress was made in the past decade in terms of access to ICT and in improving speeds. The rise has been global in nature and many countries are reaching near universal access through a combination of fixed and mobile connections.

Policy-makers and executives now recognize that those left behind, including in rural areas, are falling ever further behind in a digital society. Almost nine in ten survey respondents (89%) say their understanding of the digital divide has improved in the last three years. Perhaps because of their own edification, four in ten (39%) also say not enough attention is given to the digital divide in their country today, particularly as two-thirds of policy-makers (67%) say digital skills are now crucial and will become even more important in the years to come”ⁱⁱⁱ.

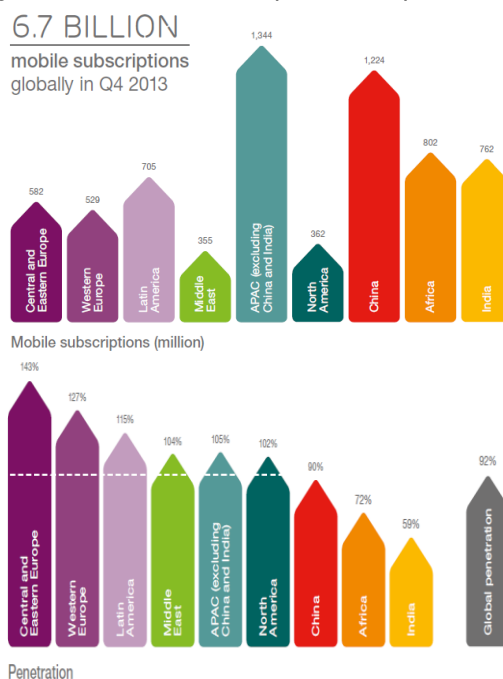
Analyzing the literature and the recent surveys from CISCO, Ericsson, Gartner etc., the article reveals, in the following sections, some of the growth drivers of ICT and their trends in the short and long run. ICT are constrained by the Internet speed and availability, the performances of the devices (PCs, notebooks, smartphones, tablets, smart watches etc., their processing power, storage capabilities, and their degree of absorption in the business flow).

2. Traffic prospects

Today, anybody can “text” or “call” via apps like WhatsApp, Facebook, Gtalk, Skype, Yahoo Messenger, SMS etc, accessible on smartphones, tablets, smart TVs and other smart gadgets. According to Ericsson’s “Mobility report on the pulse of the networked society”, at the end of 2013, there were 6.7 billion mobile-cellular subscriptions, almost 94 percent of the world population. In a CISCO Report, (CISCO, 2014:1), global mobile data traffic grew by 81 percent in 2013 reaching 1.5 exabytes per month at the end of 2013, up from 820 petabytes per month at the end of 2012. In

2012, mobile data traffic was nearly 18 times the size of the entire global Internet in 2000. One exabyte of traffic traversed the global Internet in 2000, and in 2013 mobile networks carried nearly 18 exabytes of traffic. Half of the traffic was video. In order to keep pace with demand, policy-makers and regulators should consider adopting regulatory measures to promote flexible and effective frequency-management tools such as spectrum trading and reframing. According to (Ericsson, 2014:1), Central and Eastern Europe lead the way in terms of mobile penetration (143%) followed by Western Europe and Latin America. China, Africa and India have the lowest mobile penetration rates, lower than 90 percent, though they have the numbers, due to the size of the areas, technical difficulties and, sometimes, poverty.

Figure 2.1. Mobile subscriptions and penetration



(Source: Ericsson, 2014: 2)

In any case, the forecasts displayed in the (Table 1) show an increase in mobile subscriptions (from 6% to 55%), in traffic (25% to 45%) and in mobile traffic (10 fold to 20 fold) depending on the type of the analyzed smart device. It is worth mentioning the expansion of the traffic generated by the tablets which will grow 20-fold between 2013 and 2019.

Table 2.1. Mobile subscriptions essentials

Worldwide mobile subscriptions	2012	2013	2019 forecast	CAGR [*] 2013-2019	Unit
Smartphone	6300	6700	9300	6%	millions
Mobile PC, tablet and mobile router subscriptions	1300	1900	5600	20%	millions
Mobile broadband subscriptions	1500	2100	8000	25%	millions
Mobile subscriptions, GSM/EDGE-only	4300	4300	1200	-20%	millions
Mobile subscriptions, WCDMA/HSPA	1200	1600	4800	20%	millions
Mobile subscriptions, LTE	70	175	2600	55%	millions

(Source: Ericsson, 2013: 30)

*CAGR: Compound Annual Growth Rate

Table 2.2. Traffic essentials

Traffic essentials	2012	2013	2019 forecast	CAGR 2013-2019	Unit
Monthly data traffic per smartphone	450	600	2200	25%	MB/month
Monthly data transfer per mobile PC	2500	3300	13000	25%	MB/month
Monthly data traffic per tablet	750	1000	4500	30%	MB/month
Total monthly mobile data traffic	1.1	1.9	18	45%	EB/month
Total monthly fixed data traffic	30	40	140	25%	EB/month

(Source: Ericsson, 2013: 30)

Global mobile data traffic will increase almost 16-fold between 2012 and 2019, reaching 18 exabytes per month by 2019. Experts from International Telecommunication Union (ITU, 2013:1) refer to Ericsson forecasts that by 2018 there will be 6.5 billion mobile-broadband subscriptions, almost as many as there are mobile-cellular telephone subscriptions in 2013. Mobile broadband is the fastest growing market segment over the past few years, with a 40 percent average annual growth (CAGR) since 2007.

In developed countries, mobile-broadband uptake continues to grow at double-digit rates and has not yet reached saturation, although a slowdown is to be expected in the near future. In developing countries, mobile broadband took off in 2010, and penetration rates will have increased from 4.4 per cent to almost 20 percent by end 2013.

Table 2.3. Mobile traffic growth

All mobile data	Multiplier 2013-2019	CAGR 2013-2019
Smartphones	10	45%
Mobile PC	4	25%
Tablets	20	65%

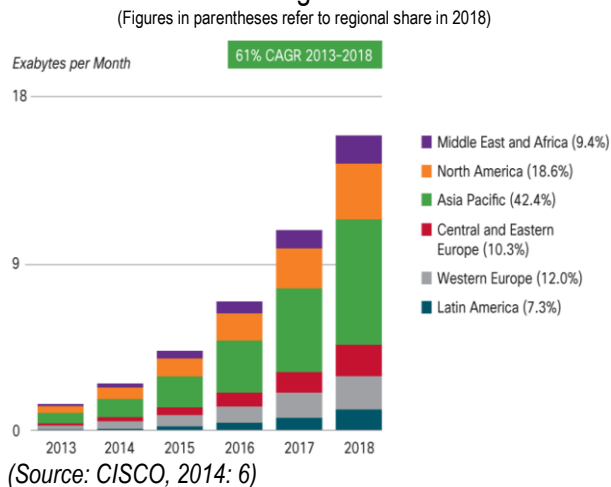
(Source: Ericsson, 2013: 30)

The growth in traffic, mostly driven by smartphones, is closely linked to the spread of 4G services. According to CISCO (2014:2,3), 4G traffic will be more than half of the total mobile traffic by 2018 (*In 2013, a fourth-generation (4G) connection generated 14.5 times more traffic on average than a non-4G connection. Although 4G connections represent only 2.9 percent of mobile connections today, they already account for 30 percent of mobile data traffic*). The top 1 percent of mobile data subscribers generated 10

percent of mobile data traffic, down from 52 percent at the beginning of 2010.

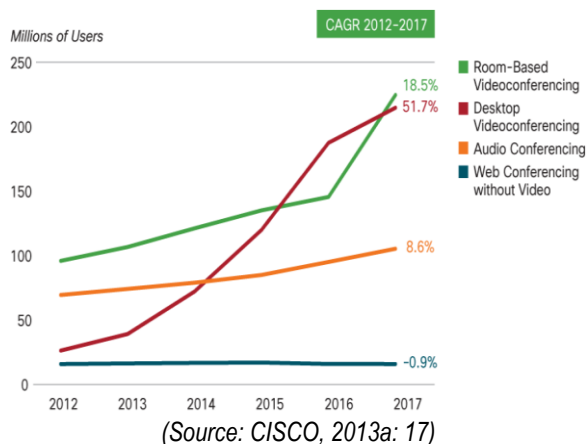
Ericsson's research (Ericsson, 2013:11) emphasizes that in 2013, online video represented 35 per cent of mobile data traffic and in 2019 will account for 50 per cent of mobile data traffic. Video conferencing, for example, is expected to become the preferred business communications tool in the next years. Bigger screens and 4G speeds make smart TVs, smartphones and tablets the devices of choice for online collaboration.

Figure 2.2. Global Mobile Data Traffic Forecast by Region



According to a Cisco Report (CISCO, 2013a: 5), globally, desktop videoconferencing will be the fastest-growing service, with 26.6 million users in 2012, increasing to 213.5 million users in 2017 (51.7-percent CAGR). Globally, web conferencing without video will decline from 16.7 million in 2012 to 14.9 million in 2017. Among the business data services tracked, desktop videoconferencing will be the fastest-growing service over the forecast period, with a CAGR of nearly 52 percent.

Figure 2.3. Growth of Business Videoconferencing Services



The Asia Pacific and North America regions will lead in mobile data transfer, counting for two-thirds of global mobile traffic by 2018.

Middle East and Africa will experience the highest CAGR of 70 percent, increasing 14-fold over the forecast period. Central and Eastern Europe will have the second highest CAGR of 68 percent, increasing 13-fold over the forecast period. The emerging market regions of Asia Pacific and Latin

America will have CAGRs of 67 percent and 66 percent respectively (CISCO 2013).

An report from Ericsson (Ericsson, 2013a:1) reveals that, in OECD countries, gaining 4 Mbps of broadband increases household income by USD 2,100 per year after, while in BIC countries, introducing a 0.5 Mbps broadband connection increases household income by USD 800 per year. Mobile-broadband networks enable people to connect to high-speed

3. Cloud computing

Cloud computing is a model of externalized data and applications storage, usually hosted by a third party. If you don't have enough storage space on your hard drives or servers, you can rent it, or pay it as you go from Cloud providers.

Cloud computing enables smaller companies to compete with larger enterprises by removing barriers associated with expensive server tools and technologies

- SMBs are prime early Cloud adopters and, given that 95% of European businesses are SMBs, Europe is strongly positioned to take the lead in Cloud adoption.
- The wide range of Cloud services now available means that SMBs simply need an Internet connection to start their operations. Cloud computing could create approximately 400,000 SMBs in Europe as well as potentially add between 300,000 and one million new jobs over the next five years.
- SMBs who have embraced mobility have generated 40% higher revenue growth in the last 12 months compared to those who did not.
- Cloud computing is up to 40 times more cost-effective for an SMB, compared to the alternative of running its own IT system.^{iv}

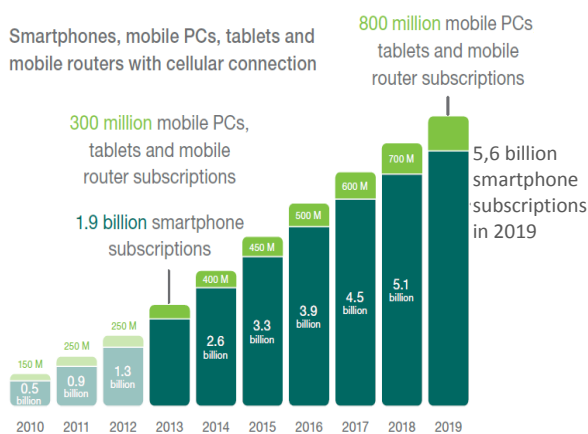
According to (CISCO 2014:3), by 2020, cloud will represent nearly 30% of all IT spending and by 2015, 35% of enterprise IT expenditures for most organizations will be managed outside the IT department budget. 46% of North American IT leaders are seeing an increase in rogue purchasing by business teams. This number increases to 73% in the Asia-Pacific region. 57% of IT leaders saw the size of their IT organization and its headcount increasing as a result of cloud deployments. In Asia Pacific, this was 80%; in Latin America, 69%. Line-of-business executives are driving more IT spending than ever before. In 2014, and continuing through 2017, IT spending by groups outside of IT departments will grow more than 6% per year -

almost 2.5 times the rate of the IT department - led by marketing, customer service, and sales groups. 75% of IT leaders in North America believe IT will act increasingly as a “broker of services” to the business. This number increases to 92% in the Asia-Pacific region. *Cloud will be a \$100 billion market by 2015.* The cloud -whether public, private, or hybrid- is already here. Today, cloud solutions occupy a significant share of IT spending, 23 percent, and respondents see this share rising to 27 percent by 2016. Private cloud is the most common cloud deployment method, at 45 percent. On June 24th 2013, Oracle and Microsoft announced plans to work closely together in the “cloud”—the business of delivering software and services over the internet.

4. Smartphones, tablets, mobile PC’s

According to Business Insider, the worldwide smart connected device market, (PCs, tablets, and smartphones), was forecasted to grow 28% in 2013, slightly lower than the 30% growth in 2012. At the end of 2013, global smartphone penetration reached 22% of the global population (5% penetration in 2009), an increase of nearly 1.3 billion smartphones in four years. At the beginning of 2014 there are two smartphones for every nine people on earth. Tablets needed only two years to reach 6% penetration as compared with smartphones which took 4 years to reach that level^v.

Figure 4.1. Smartphone, tablet, mobile PCs and mobile routers subscriptions



(Source: Ericsson, 2013:9)

Smartphones account for 29 percent of global mobile subscriptions — totaling 1.9 billion devices at the end of 2013 and will grow almost 3-fold over the next 5 years. The number of mobile subscriptions for mobile PCs, tablets and mobile routers is expected to

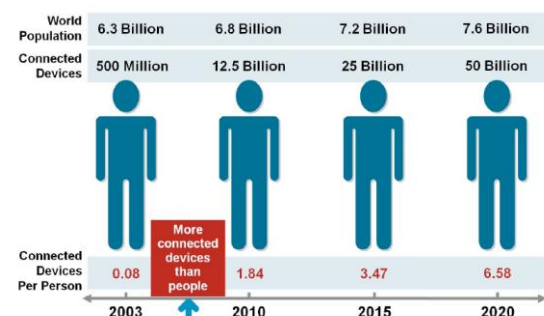
grow from 300 million in 2013 to around 800 million in 2019 (2,7-fold increase). According with Ericsson (2013), “there are a large number of PCs and tablets without a mobile subscription. Many tablets do not have a subscription because of the current price difference between models that are Wi-Fi-only and those with mobile capabilities. Another reason is that some tablets that do have mobile capabilities do not have a subscription – their owners choose to connect using Wi-Fi instead. However, mobile-capable models are expected to represent an increasing share of tablet sales”. Ericsson’s statistic doesn’t include those mobile PC’s and tablets. Market research firm Gartner expects that 326 million tablets will be sold in 2015, compared to less than 20 million units in 2010.

5. The Internet of Things

The Internet of Things (IoT) is the network of physical objects accessed through the Internet, as defined by technology analysts and visionaries. These objects contain embedded technology to interact with internal states or the external environment. In other words, when objects can sense and communicate, it changes how and where decisions are made, and who makes them^{vi}.

In the book called “Getting Started with the Internet of Things”, Cuno Pfister, explains how (IoT) works. “A sensor can measure the humidity in a flowerpot, and a computer-controlled valve (actuator) lets water pass into the pot when the humidity drops too low. Moreover, since the hardware allows the use of standard Internet protocols, monitoring and controlling can be done over the Internet. Various Internet services can be used for storing data, visualizing it, sharing it with other people, etc. ... This provides another reason why we should try to learn how such systems work. This understanding is, or at least ought to be, the basis for thinking about privacy policies that will become necessary sooner or later”.

Figure 5.1. The Internet of Things Was “Born” Between 2008 and 2009



(Source: CISCO, 2011:3)

(Cisco 2011:3) predicts there will be 25 billion devices connected to the Internet by 2015 and 50 billion by 2020.

Two enabling factors are driving this Internet of things: the ubiquity of networks and ever lower prices for the communications modules used to connect devices. Ericsson estimates that there will be 50 billion mobile wireless devices connected to the Internet by 2020, and this could eventually reach 500 billion. For example, incorporating a communication device into each automobile, and assuming a lifespan of ten years, would result in around 700 million “machine-to-machine enabled” cars by 2020. Connecting every power socket in North America to a network as part of a smart grid rollout would easily result in 10 billion connections.^{vii} According to Gartner, Inc., IoT, which excludes PCs, tablets and smartphones, will grow to 26 billion units installed in 2020 representing an almost 30-fold increase from 0.9 billion in 2009. Gartner said that IoT product and service suppliers will generate incremental revenue exceeding \$300 billion, mostly in services, in 2020. It will result in \$1.9 trillion in global economic value-add through sales into diverse end markets^{viii}.

6. 3D Printing

In a recently published article, William Dante emphasized some of the advantages of the 3D printing:

(I). fewer wasted materials: Only the raw materials needed to create the object be it plastic filament, metal powder, or carbon fiber are used.

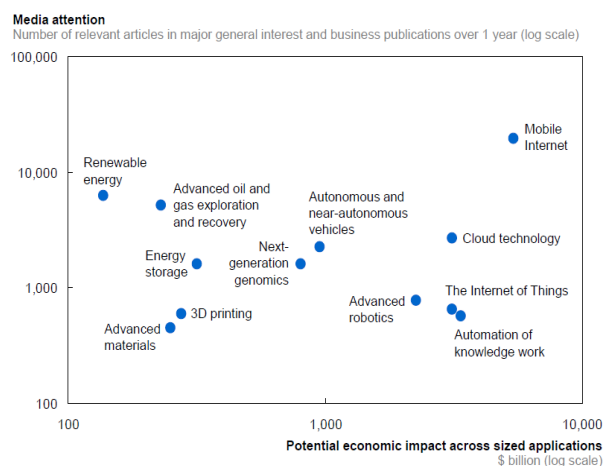
(II). possibility of longer life spans: Product parts can be replaced with 3D printing (or at least, that’s the idea for the future), so the entire product doesn’t have to be thrown away and replaced each time it malfunctions.

(III). less transport: Products often travel across many continents to get to their final destination. With 3D printing, the production and assembly can be local.^{ix}

The 3D printing industry is expected to reach a \$8.41 billion turnover by 2020 printing is the new way of creating prototyping models, furniture and common household items. The market is also categorized into four major geographic regions, namely Americas, Europe, Asia-Pacific, and Rest of the World. Developing economies such as China and India provide tremendous growth opportunities for the market manufacturing technologies, majorly, due to the rise in lifestyle and general income levels. For instance, China is aggressively taking initiatives such as huge investment and government funding in R&D, to promote 3D printing technology as a manufacturing technique. A survey carried out by engineering.com concluded that the entire 3D printing industry will register a strong,

steady growth, driven by advances in materials, output quality, speed and overall performance. As professional engineers, they see how things work in the world of manufacturing.^x

Figure 5. The relationship between hype about a technology and its potential economic impact is not clear



(Source: McKinsey Global Institute, 2013:18)

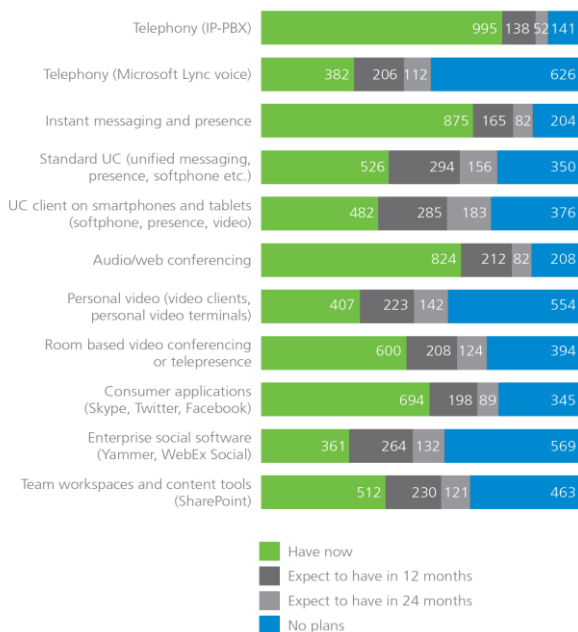
7. Unified Communications

Unified communications, or UC, is a bundle of integrated IP telephony-centric features and capabilities. These include basic Internet phone calling; traditional enhanced phone features such as call conference, transfer and forward; and a mix of enhanced communications features and capabilities. The communications features of UC, might include any or all of the following: Instant messaging (IM), presence (user availability), fax over IP, web & video conferencing, integrated inbox for emails, voicemails, missed calls and faxes, extension of some or all features to mobile devices, ability to make and receive office phone calls from anywhere in the world with Internet connectivity.

Despite investing in IP telephony (IPT), only 40% of companies (just over half of those that have IPT) support unified messaging, presence management or softphone clients on devices other than desk phones. It’s likely that these companies are not getting the most out of their IPT investments.^{xi}

There’s good uptake of instant messaging (66%) and web/audioconferencing (62%). These applications have crept into the organization quite successfully but are often not linked in any substantial way to IPT or other UCC infrastructures.^{xii}

Figure 7.1. Technologies and features. Some emerging signs of a unified approach



(Source: Dimension Data - Ovum, 2013:6)

In a CISCO Report^{xiii}, the authors emphasized the importance of UC for companies:

- UC helps accelerate decision making and ensure that the right information reaches the right person right away;
- Boost innovation: Organizations can transform business processes by integrating unified communications capabilities into business applications;
- Access a new world of value-added applications: The solution's open architecture enables deep integration with third-party solutions.

In the same report, Cisco experts identified the communication problems related to various projects:

- The inability to reach mobile and remote colleagues;
- The inability of dispersed workgroups to communicate spontaneously;
- The lack of visibility into the availability of colleagues;
- The inability to quickly locate critical decision makers;
- Scheduling concerns for collaborative work sessions.

8. Conclusions

The mobile Internet, cloud technology, the Internet of Things, 3D printing and Unified Communications revealed there is a lot of potential in the development of ITC. We will have a world of connected business, connected devices and connected people. Global mobile data traffic will increase almost 16-fold between 2012 and 2019, reaching 18 exabytes per month by 2019 creating, thus, the basis for an ITC revolution. The driving factors that support this exponential growth are: the development of new and improved technologies, financial support from companies and governments, large application areas, rapid product development at a low cost, and ease in development of custom products.

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^{vii} See note I (:7)

^{viii} See <http://www.gartner.com/newsroom/id/2636073> . 26.03.2014

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