

Potential Business Applications of Quick Response (QR) Codes

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"Technology and technological systems are integral to everything we do and can do" (Pearson & Young, 2002)

Technology is transforming the way people interact. Millions of people are impacted by advances in technology. Business organizations gain competitive advantage by early adoption of technology. Technology adoption posits many advantages to organizations and people, who use them, such as, reducing costs, availability, timelessness, usefulness and ease of use. At the end of every decade, a new technology has thrust us into the next era. Quick Response (QR) code radically ousted the bar code era. QR code is a classic example of technology advancement, which transformed the way consumers interact with sellers and service providers. Internet-enabled mobile phones have become an increasingly popular platform for use of quick response codes. These small codes are changing the way we interact with products whether it is with magazines, books, advertisements, signage or even disposable cups at fast-food restaurants. The QR codes changed how the contents are created and delivered to users. The present paper is an attempt to examine the applications of quick response codes in different industries and the paper also presents the limitations of using quick response codes and provides future direction of research.

Keywords: Technology, Quick Response, Quick Response (QR) Code, Barcode, Retail, Library.

Section I Introduction

Quick Response (QR) codes¹ are increasingly visible in the Integrated Marketing Communications (IMC) and other marketing efforts of organizations. QR codes,

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1. See en.wikipedia.org/wiki/qrcode

a type of barcode, typically appear as small white squares with black or coloured geometric shapes, readable by smart phones with a QR reader application. The codes are currently used in both traditional and interactive marketing in numerous ways. Initially used to track inventory, Quick Response codes are two-dimensional barcodes invented by a Japanese firm in 1994 (Rouillard, 2008). Since introduction to industry, QR codes have immigrated into consumer markets. Due to the capability of smart phones to utilize needed reader application software, QR codes can play a role in integrated marketing communications, specifically the mobile marketing portion of IMC. Upon being scanned through a camera in a mobile device the QR code reader application allows users to access a variety of information sources including URLs, SMS messages, V-cards, images, instant messages, and e-mail. QR codes allow the integration between print media and the online world to be processed more quickly (Ebner, 2008). QR codes provide practitioners of integrated marketing communications a bridge between traditional marketing communication methods (print advertisements, coupons, signage, sales promotion, etc), and the digital marketing realm (Flyte, 2011). As they can be used with a wide array of the promotional mix, QR codes can be utilized across an integrated marketing communication effort to offer users access to richer and interactive marketing content. The purpose of this paper is to examine the working of quick response codes and their applications in various industries. The paper is organized into three sections. First section defines quick response codes, how they work, and how they are different from barcodes. Second section presents the applications of quick response codes in various industries and last section states advantages and disadvantages of using quick response codes which is followed by conclusion.

Defining Quick Response (QR) Codes

QR means "quick response," and it does just that, a quick scan that directly links you to videos, web pages and simple text messages. A Japanese company, named Denso-Wave, first developed QR codes, in 1994, and were approved by ISO in 2000. These, two-dimensional graphic images of high-density are basically just barcodes comprised of digital squares instead of bars. The composite of these "squares," often looking like crossword puzzles or steroids, come together to create codes, which, in turn, house the data that are scanned by mobile devices. The devices quickly scan and digest the code's information block, translating it into hyperlinks or text information.

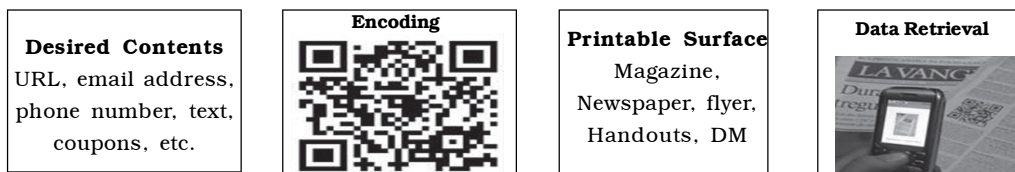
The storage capacity of QR code is normally from 3000 to 7000 characters. The QR code can still be decoded and completely read if it is defiled in an area of less than thirty per cent of the total area. The readers of QR code include conventional handheld communicating devices, such as mobile phone, personal digital assistant, etc. They are equipped with a built-in camera and decode software so that they can decode the concealed data of the code. The QR code is constructed

of normally square modules set out in a regular square array and shall consist of an encoding region and functions patterns, namely, finder, separator, timing patterns, and alignment patterns. In a nutshell, QR codes are barcodes that are pushing the limits by quickly linking us from physical products to the digital world also known as "hard linking." These small codes are changing the way we interact with products whether it is with magazines, books, advertisements, signage or even disposable cups at fast-food restaurants. Many companies today are using these codes not only for providing quick links to information, but also because they are typically free to generate. QR codes are being used across a wide variety of mediums. They allow for easy tracking of offline marketing efforts, provide a new channel for direct sales, and help stretch advertising dollars.

Section II

How QR Code Works

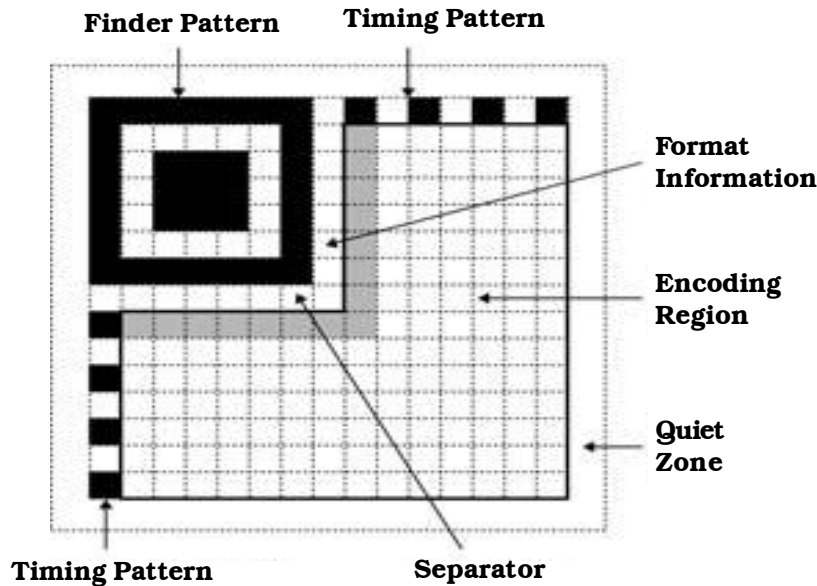
QR codes can contain a diverse range of information, including Website URLs, e-mail addresses, product images, and coupons (Sun, Sun and Liu, 2007). The codes can be placed on different media such as magazines, newspapers, posters, packages, labels, and receipts. The primary benefit of QR code is its pivotal role as a bridge between offline and mobile media in multichannel marketing. In fact, QR code is one of the few alternatives that enable consumers to transfer from one medium to another, more or less instantaneously one of the most suitable tools for multichannel marketing. For example, by simply scanning a code with a mobile device, a consumer can be immediately directed to the advertiser's campaign site.



Source: Okazaki and Li (2011)

The QR code is constructed of normally square modules set out in a regular square array and shall consist of an encoding region and function patterns, namely, finder, separator, timing patterns, and alignment patterns. Code is one type of QR code, showed in Figure 1. Azuma (1997) took augmented reality as the diversification of virtual reality. AR allows observers to view virtual objects overlapping over the real world. The equipment of AR requires AR image card, camera, virtual object, and the processing software and hardware as well. Mark Billinghurst (2005) indicated that AR image can be recognized by a personal mobile device. Hence, despite the recognition software, the physical requirements in hardware for QR and AR technologies can be same.

Figure 1
Structure of Version M3 Micro QR Code Symbol



Source: Chen, *et al.*, 2010

Why QR Codes

QR codes allow consumers a more streamlined and quicker method to connect with and consume content (Salz, 2008). Mullane (2011) defined such content to include items such as:

- Additional, detailed product information
- Coupons and special offers
- Insights on product usage and benefits
- Customer feedback forms
- Brochures and similar marketing materials
- Links to social media

Pullium and Landry (2011) has documented following feature of QR codes:

- QR code is freely available – a lot of free online QR generators exist, and Denso Wave chooses not to exercise its patent rights. Most generators offer free scanning software for users.
- QR code is an ISO (International Organization for Standardization) standard. No matter what region they are created in, a QR code is going to be a QR code.

- ❑ QR is well-designed with a higher capacity than other matrix codes, such as Data Matrix, QR is an ideal container for large amounts of data. QR also sports great size variability and error correction capabilities. Up to 30 per cent of damaged or obscured data can be restored.
- ❑ QR code is enriching – QR codes tie the physical to the digital. They also can deliver content with a great depth of interactivity.

Barcode and QR Code

Every consumer is familiar with the standard barcode found on most products. It is that long code that gets scanned when we purchase a product. So, how do Quick Resource (QR) codes compare to barcodes? In the looming battle between QR code *vs* Barcode, QR codes are capable of storing much more information than the typical barcode. In addition to this greater information storage capability, QR codes can store many different data types. They can be scanned faster, missing data can be restored, and their structure can be appended to allow printing the code on a narrow surface.

- ❑ Barcodes are seen on almost every product we purchase. From grocery items to electronics and household items, barcodes are a fixture in our lives. Barcodes are one dimensional numeric codes that store upto 20 numeric characters. This allows merchants and suppliers to keep track of inventory both coming into stores or suppliers and being sold or transferred. Where as QR codes are two dimensional codes storing data both horizontally and vertically. This allows QR codes to hold upto 7,089 characters of data. The data encoded can include numbers, alpha numeric characters, symbols, text symbols such as Kanji (Japanese language symbols), as well as control codes. Because these codes are stored both horizontally and vertically, a QR code can hold the same information as a barcode in 1/10 of the space. QR codes hold much more data. In fact, QR codes can hold text messages, website address, V. card contact information, phone numbers and more. Barcodes can only hold upto 20 numbers. In the battle between QR code *vs* Barcode, QR codes are the winner in terms of data storage and increased functionality.
 - ❑ Barcode readers will not be able to scan a damaged or dirty code, whereas benefit of using QR codes is that it can be scanned. Upto 30 per cent of code words in a QR code can be restored depending on the amount of damage. Hence, QR code are superior in recovering lost or damaged data.
 - ❑ Barcodes must be scanned in the correct position. Think of a cashier at the local grocery store. If he does not position the barcode correctly, the item will not scan. QR codes can be scanned from any position. This is due to the three position detection patterns located in three corners of the code. The reader will locate these three detection patterns and know how to correctly read the code. This feature speeds up the time needed to scan objects as the objects do not have to be correctly positioned to be properly scanned.
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- ❑ The data on a barcode cannot be divided up. Compared to bar code a large QR code can be divided into as many as 16 smaller squares. This feature allows all the information in the larger QR code to be stretched out on an object. Thus, a larger QR code can be printed onto a narrow area. This allows greater flexibility as to where a QR code can be located.

Examining QR code in comparison to barcode, it is noted that barcodes have been the standard for many years. However, when comparing QR code *vs* Barcode, it is easy to see why barcodes are being replaced by the newer QR codes. These QR codes are becoming more common place due to their greater storage potential and ease of being read by a scanner. Damaged data can be restored from a QR code but not from a Barcode. Thus QR Codes are more reliable. In the battle between the typical Barcode *vs* QR codes, it is easy to see why QR codes are coming out on top.

Applications of Quick Response (QR) Codes

Quick response codes have transformed the way consumer interact with products, a quick scan pulls all the information about the product. Quick response codes have wide applications.

Applications in Mobile Operating Systems

QR codes can be used in Google's mobile Android operating system via their own Google application or third party barcode scanners like ZXing. QR codes can be used in iOS devices [iPhone/iPod/iPad] *via* third party barcode scanners. The browser supports URL redirection, which allows QR codes to send metadata to existing applications on the device. Nokia's Symbian operating system features a barcode scanner which can read QR codes, while mbarcode is a QR code reader for the Maemo operating system. In the Apple iOS, a QR code reader is not natively included, but more than fifty paid and free apps are available with both scanning capabilities and hard-linking to URI. Google Goggles is also available for iOS. With Black Berry devices, the App World application can natively scan QR codes and load any recognized Web URLs on the device's Web browser. Windows Phone 7.5 is able to scan QR codes through the Bing search app. They can also be used on the Nintendo 3DS. There are a number of websites that provide QR code decoding. The lack of functioning tools for decoding from image files or webcams within either the MacOS or Linux PC-based operating systems make this standard unpalatable as a data-backup method for storing private data, such as passwords or encryption keys.

Applications in Retail Industry

In retailing, it is virtually impossible to plan or to schedule "production" – that is, the demand by consumers for specific merchandise especially for individual stock-keeping units (SKUs). At any point in time, a retailer needs to try to have a wide enough variety of merchandise to satisfy the wants and needs of the customers who come into the store on that particular day. Thus, in order that

consumers' desires be satisfied, merchandisers must strive to maintain a complete inventory at all times. The objective cannot be to have no inventory, except for unusual items or unusual points in time, such as bake shop products at the close of the day or Christmas decorations the day after Christmas. A QR strategy requires new and different partnerships between vendors and retailers. These relationships generally are unlike those typically found either before a retail firm adopts QR or in firms which have not yet adopted QR. With QR, the retailer agrees to provide the vendor with sales data, by SKU (e.g. colour, style, and size). The vendor agrees to hold these data confidential – the data are to be used only as needed to fulfill the QR programme with the specific retailer. Providing these data requires changes in retailers' attitudes towards vendors. In the past, such detailed information has been held confidential by most retailers; typically, it has not been available outside the retail firm itself. The implementation of QR strategies requires significant shifts in the roles and responsibilities of people and functions in both the retail firm and the vendor organizations. For effective QR partnerships, retailers and vendors must understand each others' need for information. Agreement must be reached on the information to be supplied to each, on the systems and equipment to be used for transmitting the information, on the timing of both the information and the inventory flow, as well as on factors which are involved in any vendor-retailer transaction, such as terms of sale. In addition, determination must be made concerning:

- ❑ The levels of merchandise to be stocked in each store of the retail firm;
- ❑ The locus of responsibility for barcoding prices and item descriptors;
- ❑ The frequency of merchandise delivery;
- ❑ Whether the merchandise will be shipped to a distribution centre; and
- ❑ If so, whether the goods will be separately bundled and marked for the individual selling unit.

Transportation systems and timing of merchandise shipments must be an integral part of QR if the process is to reach its full potential. Generally, without QR, most such dimensions of merchandising have been controlled by the retailer's merchandising and buying staff. However, with QR the retailer and the vendor must reach agreement on these factors in advance of shipment of merchandise. Thus, with full implementation of QR strategies, the buying and merchandising roles in retailing generally no longer involve many of the aspects of day-to-day re-ordering which typically have required significant shares of the time and effort of buyers and merchandisers. Rather, with QR buying and merchandising, responsibilities emphasize detailed seasonal planning of merchandise lines and items (plans which the vendor will implement), developing and maintaining good relationships with vendors, and the research necessary for the introduction of new items and lines. Once a QR system is functioning, inventory plans should not be adjusted by either the retailer or the vendor. Any necessary changes are accomplished as reactions to the model of expected sales which has been developed by the retailer cooperatively with the vendor. The model which is used to determine

the amount of merchandise needed by the retailer allows for minimum inventory levels, as well as the necessary changes in stock levels resulting from seasonal, promotional, or other shifts in consumer demand. Without such a variable model, retail buyers would find it necessary to interfere with the automatic reordering features of QR, as demand changed. Many retail firms which have adopted QR, as well as observers of the growth of this strategy, report that the primary key to success is management's full support and enthusiasm for the QR strategy and for what QR means to the firm. Both the retail firm's and the vendor's top management must be committed to QR and must understand the impact on the organization of its implementation. Each must communicate commitment to QR as well as the implications of that commitment to all involved. The managements must instill trust and confidence in the strategy and between all the personnel of the organizations that interface with this strategy, including merchandising, buying, shipping and receiving, inventory control and accounting staffs.

Applications in Library

Library Journal columnist Michael Kelley has written, "As QR codes become more prominent in daily life, librarians are seeking the best way to incorporate this simple and free technology into their operations" (Kelley, 2010). The practical aspect of the QR code scanning software in budget-conscious times is that the application can be downloaded free to one's smart phone.

- ❑ In a typical library-based scenario, "a student who scans QR codes from a library catalog in the middle of the night in his or her dorm room could head to the library stacks the next day, click open the application to refer to the call numbers of the titles scanned the night before, and quickly find the books" (Ashford, 2010a).
- ❑ QR codes can also support the ever-evolving environment of e-book access in libraries, where, as an example, "you could go further and share an entire eBook and even multiple pieces of content that share a common link" (Korhan, 2011).
- ❑ A Best Practices Wiki "where librarians have been listing their successful uses of the QR codes in areas including art gallery information and links to resources about the artists, links to library audio tours, information regarding the library's text messaging service, links to video information friendly to smart phones, codes on study room doors connected to room reservations, a code connection to computer reservations system and many more services" (Ashford, 2010b).

Applications in Publishing

Numerous book, Journal, magazine, and newspaper publishers around the world are using QR codes in their publications. For publishers and advertisers, the ability of QR codes to add value, track responses, and generate additional revenue is a powerful draw. QR codes offer publishers more than a few compelling benefits.

Using the codes allow publishers and advertisers to add value to static print publications. They also allow publishers and advertisers to trace response to a print ad quickly; the number of people who access content through a QR code can be tracked in real-time and automatically. Book publishers are adding QR codes to book jackets to lead readers to author interviews, book reviews, reader communities, and other content that supports the book. For example, a book on services marketing might sport a QR code that links to the author's marketing blog. The latest book in the Twilight series might have a QR code on the book jacket that links to updates on when the movie version will be released, along with a trailer and exclusive interviews with actors. Magazine and newspaper publishers are adding QR codes to editorial pages to add interactivity and timeliness. The codes might direct readers to exclusive content such as photo albums, video interviews, or downloads. QR codes give advertisers an easy way to track response. QR codes provide an immediate response mechanism for magazine advertising. They also provide an excellent tracking mechanism for proving that people are viewing the ads and are responding to them.

Another application of QR code is success forecasting. An excellent example of this is when, a publisher wants to promote its new digital journal, book or magazine. Xtreme Coated, publisher places an ad in social media, a publication that targets print sales. To promote the fact the paper does not crack on the fold, the advertisement encouraged people to snap the QR code, which took them to a Web site landing page they could request free samples. Using the QR code allows tracking the:

- Total number of scans (responses),
- Devices used and number of scans on each device,
- Number of people scanning the code on a phone *versus* typing in the URL,
- Number of people who filled out the form, and
- Number of people who requested samples.

Applications in Textile-Apparel Industry

Quick response strategy acts on the single phases/activities throughout the entire chain – right from the producers of yarn upto the sales outlets – with the aim of reducing the time spans that elapse from the textile design stage to the purchasing of the garments by the final consumer. In QR strategy, time compression is seen as a goal on the one hand, and on the other, as an instrument for the improvement of company performance in terms of efficiency and the level of service offered. This improvement can be translated into an increase in company competitiveness and, for the final consumer; it can also have the effect of a reduction in prices. Information technologies and telecommunication constitute one of the means which can be exploited by textile-apparel companies for the improvement of time performance.

QR strategy analysed the role played by information technology and telemetric in the realization of this, can be summarized as follows. QR is a time-based strategy which requires greater collaboration along the whole textile apparel chain, from the yarn manufacturer, the fabric manufacturer, the garment manufacturer through to the distributor. Hence, the choices and behaviour of the guiding companies within the chain seem to be fundamental. Even though ultimately QR must be the common aim towards which all the companies in the chain should work, independently of their role or the product they produce or distribute in the chain (basic/continuative, seasonal, fashion), in that it is a strategy that makes it possible to increase company competitiveness, the application of QR today seems to be easier in the case of basic/continuative products. The operative integration of the players in the chain, a key requirement in QR, both demands and favours the full use of telecommunications where the relations between telecommunications and integration strategies reinforce each other (cf. "virtuous circle"). The adoption of information technologies and telecommunications brings advantage such as the reduction of document transfer times between companies, and an increase in reliability, precision and certainty in data transfer, and the elimination of document insertion time in company information systems. However, QR strategy is achieved not only through the support of innovative technologies oriented to the management of the "information flow", such as information technologies and telecommunications using the barcode and scanner systems, but also through the innovative management of the "physical flow", such as the definition of planning and scheduling systems integrated downstream, flexible-modular systems for garment production, innovative systems for textile dyeing, and new design systems in the garment and textile sectors. The operative strategy of QR could use the opportunities offered by modern technologies to redesign the processes of the entire textile-garment chain. In order to achieve this very difficult aim, serious business process re-engineering is necessary, as well as an indepth analysis of current processes, in terms of creating links between the various activities and decisions, and comparing them with the new operative modalities which are becoming more widespread with the introduction of these new technologies into companies.

Applications in Education

Bridge the Gap between Paper and Web – Teachers who integrate multimedia projects into their classroom often have the issue of displaying the work on a paper based, physical bulletin board. With QR codes, the teacher can post a paper-version of the student's work on the bulletin board, and affix a QR code next to it for others to see the "enhanced" version. Specifically speaking, a site like Glogster prints out great for boards, but has interactive elements like audio, animation, and even streaming video that are not possible to reflect on a board. If the student generated a QR code for their Glogster, anyone can see on the board their work, then take a snap of the QR code to see the videos, audio, and animations that are found within the electronic version (same for blogs or Wikis that have great writing, but reference embedded content).

Virtual Business Cards – Students could have a QR code that is linked to their Blog or Wiki, printed out on a card, and taped to their desk. That way, at any time, the teacher, administrator, parent, or other students can take a snap of the QR code, and see what the student has been writing about recently. Once students know that any and everyone will be checking their portfolio at any time, their enthusiasm and dedication will increase. This idea can also work for Back-to-School Night or Open House. QR codes can be displayed around the school in different locations that link to a variety of media. Parents could take a snap shot of the QR codes to view video introductions of teachers or students discussing different elements of the classroom.

Personalized Lessons and Differentiated Instruction – For students who need supplemental material, either accelerated content or English Language support, a teacher using PowerPoint to present a lesson could embed codes in slides for those students. For instance, many curricula come with English Learner handbook activities that are supplemental to the lesson. Often they have extra vocabulary, visual support, or scaffolded activities. Instead of them having to wait for small group time, or sitting through a lesson they are confused about, they could snap a pic of the QR code, get the materials they need for that slide, and keep up with the class. Additionally, GATE students could snap a QR code from the slide, which takes them to a Web Quest or accelerated activity to do in support of what they are learning.

Section III

Advantages and Disadvantages of Using Quick Response (QR) Codes

Advantages

- ❑ A quick scan captures all the desired information, you are looking for and it is hustle free, moreover there is no need to write vital details down.
- ❑ QR codes can be used to store addresses and URLs that can appear in magazines, on signs, buses, business cards or just about any product that users might need information about.
- ❑ Advantage of using QR code is that it can read almost anything as long as it is online, it is readable. The cell phone's camera and sensor has got more use now, instead of merely capturing moments in time, it is the link to an online world with the help of a QR code reader.
- ❑ Advantage for using QR code include information being made to you regardless of who you are. Education, advertisement, saving for companies focused on branding their product or services, and much more.

Disadvantages

- ❑ Users must be equipped with a camera phone and the correct reader
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software that can scan the image of the QR code. Currently only smartphones are technically equipped to do this. Many users that have mobile phones that have cameras are unable to get QR reading software for their phones.

- ❑ Another disadvantage for using QR code is that smartphones are far more expensive compared to the conventional phones. It is a kind of investment for internet-savvy people but for those who are old, such as above 45 years, there is absolutely no need to waste such money on technology.

Section IV **Conclusion**

The future of coding era will be defined by how coding and decoding devices communicate with one another, with human beings, and across different environment. Proper positioning of these codes on static surfaces can function as an additional marketing tool for decision makers to employ for those tech-savvy users eager to embrace the latest marketing techniques that may prove as successful for business, as for its retail and e-tail counterparts. However, in this case, the manner by which the codes themselves are used in different industries, more appropriately offer a key to unlocking the message unseen within, that, once opened, brings to the user a wider range of informational services that this technology can provide. As new coding technologies emerge and are adopted by businesses, organizations and people, technology will play a big role in addressing the needs of customers in the coding era. Generation Y (Gen Y) or 'Millennials' is a critical emerging market for new technology such as QR code. The members of this generation grew up with technology and rely on it to make their lives simpler, to perform their jobs better. This age group usually owns multiple connected devices such as smartphone, tablets or laptops. Gen Y is in an environment where there is an incredible, unprecedented explosion of applications, especially mobile applications. According to IDC, 'application developers have churned out more than 300,000 mobile applications in just over three years. The number of downloaded applications is expected to increase from 10.9 billion worldwide in 2012 to 76.9 billion in 2014. This generation has an entirely new set of demands and expectations about how technology should work. Hence, future of generation Y will be in the hands of technology codes. The winner in the coding era will be those who can simplify, standardize and automate their technology setup so that they can spend more time living life and managing their business rather than managing technology.

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