



# hyper@ctive magazine

emerging technologies





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# FOREWORD

This edition of Hyperactive Magazine highlights 5 emerging technologies:

- **Mobile Internet**
- **Social Analytics**
- **Big Data**
- **Hybrid Cloud Computing**
- **3D Bioprinting**

These emerging technology topics have been selected from the Gartner Hype Cycle Report of 2013.

Each article paints the technology description, makes a SWOT analysis of the technology, the applications in business, education, and various industries, cost-benefit analysis of the technology, and ethical and nation-building implications.

The article on Mobile Internet should be placed within the context of Technology Cycles in the last 10 years, viz.:

- 1960s – Mainframe Computing
- 1970s – Mini Computing
- 1980s – Personal Computing
- 1990s – Desktop Internet Computing
- 2000s – Mobile Internet Computing
- 2014+ – Wearable/Everywhere Computing

The current trend towards mobile smartwatches, glasses, internet-enabled and controlled robot cars, and flying drones shall proliferate more and more all aspects of society in a digitalized world.

The rise of social media and the various type of data from text-based, to photos, to movies, to multi-media and meta-data has led to the rise of social analytics. Using various data mining algorithms embedded in google analytic tools as well as other web-based social media analytics tools, today's social media marketers can visualize the trends in social media channels to gain competitive intelligence and discover new products and market niches that will ultimately redound to better customer service.

Related to social media and mobile internet is the rise of the content of social media due to the proliferation of mobile devices—now known as Big Data. The article focuses on the data explosion and how this can be data mined to convert into actionable and useful information.

The article on hybrid cloud computing shows the route for SMEs to make a quantum jump to match the power of bigger enterprises.

Finally, the article on 3D Bioprinting points the capabilities that will change the way of healthcare in the future as various parts of the human organs can literally be printed as evolved from the technology of stem cell and regenerative medicine.

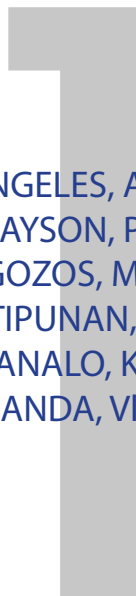
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EMERGING TECHNOLOGY ON  
MOBILE INTERNET



EMERGING TECHNOLOGY ON  
MOBILE INTERNET

# EMERGING TECHNOLOGY ON THE MOBILE INTERNET

## I. Technology Description

When your smartphone makes it so easy to connect to the Internet, why bother firing up a clunky desktop or laptop computer?

Two-thirds of cell-phone owning Americans use their phones to surf the Web and check e-mail, according to the latest study from the Pew Internet & American Life Project. That's double the amount from 2009, when only 31% of people said they used their phones to go online.

For a growing segment of people, phones aren't just a secondary way to check the news or send off a quick e-mail. According to Pew, 21% of phone owners use their devices as their primary way of accessing the Internet, more than PCs and tablets.<sup>1</sup>

So how does this mobile internet work?

Mobile internet or mobile web refers to the access to internet by the use of browser-based internet services, from a handheld mobile device, such as a smartphone, connected to a mobile network.<sup>2</sup>

Computers have come a long way in terms of size and mobility. From the big, heavy and wired boxes to handheld, light and wireless gadgets which we mostly now call smartphones. One can connect to the internet in mobile either through smartphones, wireless modem dongle connecting to laptop, tablets and others. These smartphone gadgets allows users to do some of their usual Personal Computer internet activities

like surfing the net, sending and receiving emails and documents, making a call using VOIP, internet chatting, connecting to social media and even playing online games, however this time users can do it anytime and anywhere, on the go.

These smartphones connect to the internet through a mobile network. Initially people connect to the internet from their Personal Computers through wired network or wired network connecting to WIFI router. As the technology evolve, people are introduced to 2G wireless technology which lead to the standard called Wireless Application Protocol (WAP) access. WAP has encourage the development of many wireless Web Application and services.<sup>2</sup> When people connect their smartphones through a 2G mobile network, in terms of speed in downloading, a 2G connection with a 128Kbps speed can download a 5MB MP3 file in about 5 minutes. However, connecting our smartphones today to a 4G mobile network means when downloading that same file, one can get the file in 4 seconds with a 10Mbps connection.

## II. Industry/Business Applications of the Technology

The number of internet-connected mobile devices, such as smart phones and tablets, has been growing significantly in many businesses. This is primarily due to the mobility and flexibility this technology brings. Businessmen are no longer

to their office desktop in order to respond to emails and make critical business decisions.

With the use of handheld devices, the internet can now be accessed anytime and anywhere. These mobile devices make it easier for businessmen to communicate with their staff, suppliers and clients.

The following are the major application of mobile internet in business:

### **A. Communication**

Mobile internet has made it possible for companies to connect with their clients/customers, employees and suppliers easily and efficiently. Even while traveling or when out for a meeting, one may process various office tasks, send out reports and even make presentations to clients. With this technology, one can be assured of real-time business communication.

### **B. Marketing**

Since people are becoming more and more attached to their mobile phones, businesses have seen this is an opportunity to build their presence in this platform. Mobile internet has become a good venue to reach out to potential customers through advertisements and marketing campaigns.

Studies show that the use of mobile internet will increase remarkably in the coming year. With this, many companies must also build a mobile marketing presence online to reach out to more potential customers.

### **C. Customer Service**

Mobile internet can help companies improve the services they offer to their customers by making their business more flexible and mobile.

Below are a few examples of enabling more flexible terms for customers to enjoy:

#### **1. Mobile banking**

Financial institutions, particularly banks, have now gone mobile in terms of various bank transactions such as: transferring funds, checking of balance, making online deposits and online payments. This emerging technology has made many people lives easier as they will no longer have to personally go to banks and line up just to deposit and process bill payments. A simple mobile banking account is needed to conduct these transactions.

#### **2. Mobile commerce**

Today, it is now possible to transact business online. Buying and selling is no longer confined to physical stores as there are now hundreds of online stores set up online. This is ideal for individuals who do not have sufficient time to scout malls for items that they need. The internet is now a place for commerce where buying and selling happens. The good news is that many online stores have now customized their websites to make it available for mobile viewing. This means that a consumer may now purchase products through his handheld mobile device.

### 3. Information Services

The use of mobile technology has helped companies spread out information to target audience more easily. An investor, for example, will no longer have to open his desktop or laptop to get updates on latest trading or stock information about a company. Updates may be sent to his email and he could directly check this through his internet powered smart phone or tablet.

An increasing number of companies have also taken advantage of mobile internet technology by creating version of their company websites specifically for mobile phones. This will be easier for companies to send out information to clients and investors. With this, investors may rely on these websites to get the latest information on a company's financial condition.

## III. SWOT Analysis

### A. Strengths

#### 1. Gain access to the internet anytime and anywhere

Convenience is the main strength of mobile internet wherein its users are not restricted through the use of a WiFi hotspot, or other wired broadband internet, like DSL and cable modem. But with the use of mobile broadband, like the internet data plan on 3G or 4G, that utilizes wireless technologies and are designed to broadcast signals everywhere, users of the mobile internet may be able to gain access to need information anytime and anywhere.

#### 2. Stay in touch with others

The mobile internet will enable its users to stay in contact with family and friends, and important partners or clients at work. Staying connected with family and friends are now very easy via instant messaging and social media applications. Communication between two users may now be made through a simple text message, voice messages, and now even through pictures and videos. Such kinds of communication are now very convenient, as while the users take photos or videos, they may instantly upload it to social networking sites via mobile internet and share them with their friends and family.

Moreover, gone are the days where you can only access your work e-mails and files in the comfort of your office. If your handset supports "Push E-mail," in new e-mails will automatically come to the user's handset upon their receipt through the your device's mailbox. Furthermore, files may be exchanged if necessary. As such, you will not miss any business opportunities, or important business decisions.

#### 3. Stay informed

In the past, you may only know about the latest news if you tuned-in regular schedules programs on TV or radio, or by reading the daily newspaper. And now, with the mobile internet, news may be browsed through at real time by checking the website of news channels, and social media like Twitter and Facebook. Nowadays, almost all news channels, radios and newspapers have their respective websites wherein if

you a user searches on a news the search engine will automatically bring the user to the news websites relating to the topic. Moreover, news websites also have their respective Twitter accounts in which their followers may be able to find read through real-time news bits, and also link them to their website for the full report. The most haunting effect of social media up-to-date is the Million People March that is said to be a social-media fuelled rally. Due to the use of social media there were about almost 100,000 people who attended the rally, and was also emulated on other cities around the country and around the world.

#### **4. Find relevant and useful information**

The mobile internet brings an abundance of resources to its users as it provides all kinds of information via search engines like Google, and online dictionaries like The Free Dictionary, or encyclopedia like Wikipedia. All kinds of information are now at the end of your fingertips, from doing school or work research on topics like Globalization, the Stock Market, or personal research like titles of songs by just typing in the lyrics of the songs, or how to cook adobo. Moreover, all these information may also access to different mobile applications that a user can download in his mobile device. At this day and age, users may now say goodbye to printed encyclopedias, dictionaries, and cookbooks, and just rely heavily on its mobile broadband connected device.

#### **5. Get access to entertainment and lifestyle**

Mobile internet does not only give users information and knowledge, but it also provides them access to entertainment and lifestyle. Nowadays you can be sure to never be late for a movie, with one click, you can now see the latest movies and its schedule, one can even buy the tickets online to remove the hassle of lining up in the mall cinemas. Other than movie tickets, one can also buy airline tickets, and concert tickets online. In addition, you may simply activate mobile applications to find the latest information about the latest store promotions, or which restaurant serves the best food. And not only that, with the use of handset-based navigation application, you can also find out the locations of the shops in the vicinity instantly.

### **B. Weaknesses**

#### **1. Poor internet connection in terms of range and bandwidth**

The internet connection via mobile internet may not be as fast as a laptop or desktop with direct cable internet connection via Wi-Fi. Even with the new technology like the 3G and 4G networks that offer faster mobile internet, networks are usually only available within the range of commercial cell phone towers. Thus, mobile internet is prone to connection timeouts. This particular weakness of the mobile internet may be worrisome in cases of banking transactions, or online shopping, in which in case a connection timeout occurs you may not be sure if the transaction has been completed successfully or not.

## **2. Incur additional costs**

The mobile internet service provided by cellular network companies like Globe and Smart is an add-on to your current plan line. If you are using an iPhone, and your cellular networks are activated you will be charged per megabyte download by your network provider, that is why most people subscribe to mobile internet plans. For example, for Globe Telecom, they offer the SuperSurf for both their postpaid and prepaid subscribers. Globe subscribers may register for 1 day activation of their mobile internet for Php50, 5-day use for Php200, and 30 days unlimited access to mobile internet for Php999. It is very apparent that the costs to be incurred for subscribing to mobile internet is not cheap at all, that is why one should really have a budget pertaining to this additional cost.

## **3. Increase in power consumption**

The main problem of many smart phone users when they are subscribed to the mobile internet is the quick consumption of their device's battery life. It is because when a power outlet is not available, mobile computers or devices rely heavily on battery power. And due to the consistent downloading of applications or data, battery life is easily used up. This may be very problematic when you need to use your phone for an emergency, and you have no more battery because it has been used up already. Moreover, with the recent technology, many companies have provided external battery packs to help support your

mobile devices when you are in need to recharge it.

## **4. Small screen size**

Mobile devices like your smart phones remain an awkward fit for Web browsing, or even for watching videos online. It may be able to offer convenience in getting all information needed due to its compact size, but it does not give users the best browsing experience. With the small screen size, users must constantly enlarge the web pages to be able to read through the articles, and also constantly move the screens.

## **5. Incompatibility**

Some websites, especially those with many pages and that run different scripts, may not load successfully on mobile devices. Mobile internet does not support all complex scripts available for web browsing. When a website is accessed through a mobile device that its not compatible with, the pages may not load successfully or the website may not appear correctly.

## **C. Opportunities**

### **1. Generates e-commerce**

Mobile internet did not only pave the way to access to information, but also for e-commerce. With users using their mobile devices for almost everything, setting up an e-business is now easy. Most of the known retail fashion brands like Zara, Mango, and Topshop have already set-up their respective mobile applications to keep its



customers up-to-date to its recent product launches, and this mobile applications are also used as a shopping site. Moreover, it is not only the big companies who has the opportunity to commence in e-commerce, but also small-scale businesses as well. Nowadays, small business use different social media networks like Facebook and Instagram to set-up their e-commerce site.

## 2. Expansion of telecom companies

Network speed matter to mobile internet users, and are willing to pay more for faster internet connections. A recent report from Facebook says that more than 71 percent of the activity on Facebook is via mobile devices. Thus, there is much to be expected from telecom companies to be able to fully utilize this total number of users.

## D. Threats

### 1. Prone to theft

The very portability of the mobile devices like tablets, and smart phones makes them easy to steal. The owner of the stolen phone could lose all data stored. And even with the security feature of the device, a sophisticated attacker may still gain access to the device.

### 2. Lack of security

Mobile phones do not offer the same level of privacy as personal computers. Although some websites take precautions to establish secure connections, unsafe websites still proliferate, which can gather sensitive information stored on mobile

phones. Though mobile viruses and malicious software are still uncommon, mobile phones do not have the necessary protection should it happen. Websites adapted for mobile internet do not carry the same type of encryption and security. There are no firewalls and intrusion detection systems to block unwanted traffic.

In addition, many seemingly legitimate software applications are malicious. Anyone can develop applications for some of the most popular mobile operating systems, and mobile services providers may offer third-party applications with little or no evaluation of their safety. Sources that are not affiliated with mobile service providers may also offer unregulated applications that access locked phones capabilities. Some users “root” or “jailbreak” their devices, bypassing operating system lockout features to install these applications.

## IV. Cost-Benefit Analysis

The group focuses on the cost and benefit analysis for small and medium enterprise who will deploy the mobile internet technology to their employees.

### A. Total cost of ownership

Using the Smart Communications (a Philippine Telecommunication service provider) Postpaid Plan for Unlimited Data with bundled smartphone, a company can budget 1,500/ per month per employee.<sup>1</sup>

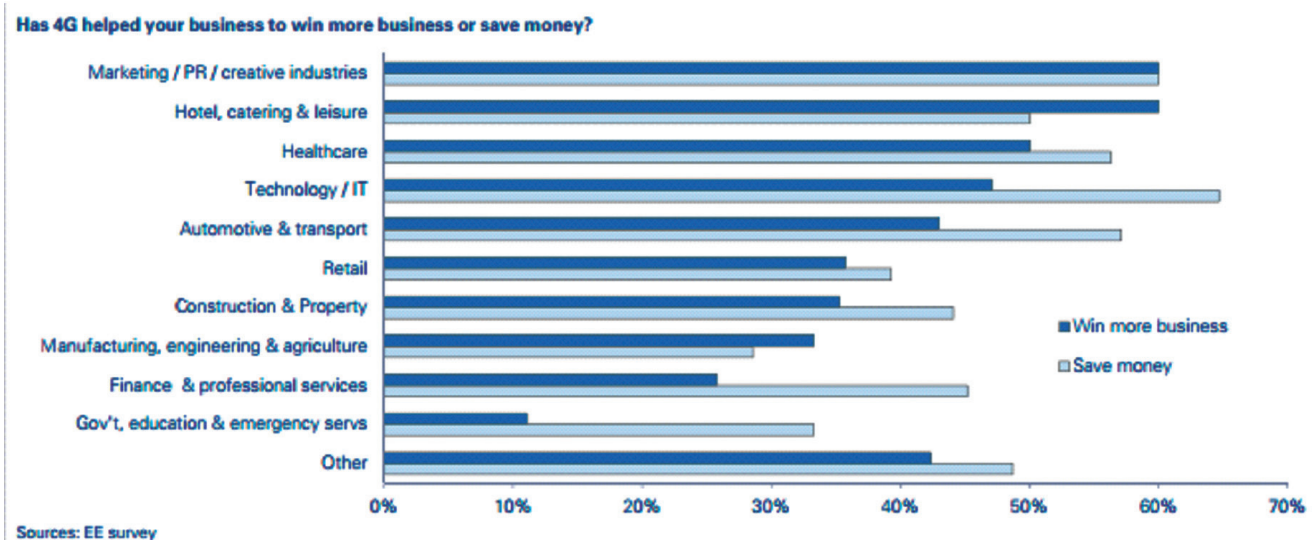
Total Cost per month = 1,500 × number of employees that will have the plan

## B. Direct and indirect benefits<sup>2</sup>

1. Increased sales and improved customer service: enhancing sales meetings with richer media, increasing the productivity of a mobile sales force, or simply being more responsive to customers when out of the office.
2. Direct cost reductions: reducing travel costs, saving office space by increasing teleworking, or saving telecoms equipment or fixed line installation costs.
3. Improved employee motivation: allowing more effective remote working, reducing wasted time, or improving application functionality.
4. Improved flexibility, agility and decision-making: providing rapid access and ability to respond to business information, or enabling improved interaction and collaboration

## C. Business impact<sup>2</sup>

In the United States, 47% of mobile internet users report identifiable cost savings and 39% report increased sales. Business in the marketing and creative industry have the biggest impact on implementing mobile internet. The figure below summarized the survey.



## V. Ethical Implications

With the proliferation of mobile devices that are capable of being connected to the internet, the question of its ethical implications arises too. Questions such as am I supposed to be uploading the pictures I took of people on the street or is it ok to browse the net while I am out on Sunday with the family. The effect can varies heavily on how the technology is used. Mobile internet enables kind of applications to be available. This can be anywhere from tracking the location of the phone, sending advertisement to users based on locations, making banking transactions on the go and the list can go on and on.

### A. Business use

Mobile devices are always connected to the internet and so as the employee. This allows the employee to work remotely and be productive though he is away. However, this also implies that the more time he spends on his mobile device outside work are time he should be spending with his family. Furthermore, the separation of the employee's personal usage of the device and professional use is intertwined. That could result in some loss of his privacy.

Business on the other hand can use internet connected devices for gain. An example would be sending advertisement depending on the search items you used on your phones or the kind of applications you have downloaded without the permission of the user of the mobile device. This is a clear invasion of the privacy of the user.

### B. Personal

Now it is not uncommon for friends or group of friends who are sitting next to each other on place of their hangout to have their mobile devices in their hand and rarely talk to each other. Families are not exempted from this as each of the family members also would have their phones in front of them rather than talking to each other. These are some of the concrete example of how the mobile internet affects relationships. Instead of personally talking to each other and take advantage of face to face interaction people are now more into using the internet through their mobile devices than the traditional methods of personal interaction.

### C. Social

Social media is playing a big part on the use of mobile internet. How many times have we heard rumors scattered all over social media sites. If rumor before was thru text messages which cost peso for every message you sent and it would be of interest for local people. Now, thru social media how fast can it go? People life can easily be broken by a single irresponsible post. The latest victim would be Jackie Chan. He was announced death on one of the most popular social media site.

In addition to this, how many blogs or articles on social media sites that we thought was true and yet it was all false. Suddenly everybody becomes an expert on items of interest for most people. For some, it affects and influence their view of the truth.

Ethics has evolved through the years, but still the basic remains the same. Respect each other and treat others as you would have like to be treated. Keeping these in mind, will minimize ethical implications brought about by this emerging technology.

## VI. Nation Building Implications

Nation-building is defined in wikipedia.com as the process of constructing or structuring a national identity using the power of the state. And that it is in the process which aims at the unification of the people within the state so that it remains politically stable and viable in the long run. Moreover, it can involve the use of propaganda or major infrastructure development to foster social harmony and economic growth.

### A. The Good and The Bad

#### 1. Knowledge-focused

Anytime, anywhere—wherever you go there are sets of data and bits of information, which most of the time leads to questions. There is a contemporary and immediate answer to the inquisitive minds of all generations, and that is accessibility of internet even when we are outside our homes, schools or workplaces. And it is very important to immediately check and verify an unknown data or information via internet. And after checking on the

information, it then turns to knowledge. Relevant knowledge we can use in situations we face. The non-street smart individuals are made street-smart in less than one minute. Make millions of individuals smarter and we make a smarter nation each day.

#### The Trade-off

There have been recent issues on individuals excessively relying on the internet. Bits of information seen in the internet are not at ALL times reliable and it should not be ultimately used in how we live or work. Worst, at times it promotes plagiarism, as it serves as an easily accessible tool to cramming students and lazy workers. Making it more accessible may ingest addiction to irresponsible users.

#### 2. Global

“The Internet speeds up the globalisation process by reducing physical barriers. Many businesses are able to reduce travel costs as online communication has improved.”<sup>1</sup>

Travel costs such as time and money have been two of the most important factors considered in sustaining a business. The availability of connecting via the internet made business transactions possible when the parties transacting are miles away from each other. A very salient example would be the mobile internet banking. A customer in the USA who is having a vacation may be able to secure a transaction in the Philippines by making a local payment transfer via mobile phone banking. Even if

<sup>1</sup>(2010, May 4) Retrieved September 22, 2013 from <http://blog.euromonitor.com/2010/05/qa-socio-economic-impact-of-growing-internet-usage.html>

the customer is in an area where there is bank on site, mobile phone internet made it possible to connect the customer to the bank and the bank to the customer. Moreover, there it can also be made real-time transfer regardless of time difference. An example would be the Premier Banking service of the HongKong and Shanghai Banking Corporation. It's made more accessible and establish a real-time transaction between parties, and more importantly, secured through an added security device feature. This makes business relationships stronger and longer, even when there's no face-to-face interaction.

#### **The Trade-off**

Insufficient security measures for some mobile internet based business applications.

### **3. Broad**

“While carrier subsidies have helped drive sales of high-end devices in mature markets, the next growth chapter will be in emerging markets where cost-conscious users demand cheaper gadgets and cheaper access to cheaper services.”<sup>3</sup>

It was cited in the article that the growth in the usage of mobile phone internet is going to be higher in the Asian region than in Europe and Americas combined. This was forecasted as there's an emerging market in producing devices that are ten times cheaper than devices in the developed countries making it more affordable to the developing countries. And by means of

having an internet access via mobile phone and other mobile equipment coverage is even made broader than ever and made available to people in almost all walks of life without the need to purchase a personal computer.

#### **The Trade-off**

Tighter competition in the market, and may even lead to an unnecessarily free mobile phone internet access. This will be detrimental to most related industries and even cause complex to uncontrollable internet traffic slowing down the system and productions.

### **4. Liberal**

People nowadays are more empowered when it comes to voicing out their opinions, especially when it comes to political issues. More channels are made available for people to express their opinions, eliminating the cost to accessibility. Social media has made a very big part in serving as a channel or even an “amplifier” of small voices to be heard in a community. Everyone can easily play a role of a messenger to the public about different issues, moreover those that are not usually traced by people not in their areas. It is media made cheaper. Democracy is promoted not only to the elites or the middle class. It promotes no boundaries which may actually be a good or a bad thing.

<sup>2</sup>Wagstaff, J and Yee L C (2013, July 23). For the mobile Internet, tomorrow belongs to Asia. Retrieved September 21 2013 from <http://in.reuters.com/article/2013/07/23/smartphones-mobile-internet-samsung-idINDEE96M06U20130723>

### **The Trade-off**

Unstructured posts, comments or opinions towards an issue may sometime not be authentic, credible or misleading that may unhealthily develop the reader's way of understanding an issue.

## **5. Personal and relational**

On a smaller scale, having an additional internet access means an additional channel where a family member, a friend, a colleague, a classmate, a student, etc. may be able to express their feelings toward an issue with someone in which they could not explicitly express face-to-face. At some point, it may improve social relationships, and in effect develops a sense of responsibility. It is better to at least know a problem or concern rather not talking about it all. Mobile phone internet access promotes urgency and makes a statement more genuine through an immediately available channel to send a message.

### **The Trade-off**

Individuals may rely on it too much that they do not consider talking about issues in person anymore. This may sometimes lead to misinterpretation.

## **B. So, does mobile internet help in building the nation?**

Yes it does help. Especially in extremely dynamic times we are living now. But knowing our limits and responsibilities in accessing mobile internet, should be a balancing act, referring it to one of Business Ethics' concepts that there should be a mesotes or "middle" of things. In fact, it may be ideal to have a formalized course or activities that would discuss about Technology and its nation-building & ethical implications. Excessive dependency on technology is detrimental. We need to advance and prosper, but at the same we should not ignore the bigger picture—that it is more important to know would prevent us from progressing and that at the end of the day it is a measure of how we can contribute to our society, how human we are in dealing with our daily tasks and the people around us.

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## EMERGING TECHNOLOGY ON SOCIAL ANALYTICS



## EMERGING TECHNOLOGY ON SOCIAL ANALYTICS

## I. Technology Description

Social analytics is a philosophical perspective developed since the early 1980s by the Danish idea historian and philosopher Lars-Henrik Schmidt. It differs from traditional philosophy as well as sociology. The practice of “Social Analytics” is to report on tendencies of the times. It does not aim to make a diagnosis of the times that can be agreed upon by everyone or anybody but a report that no one wants to protest about.<sup>1</sup>

Social Analytics is the collection and analysis of statistical, digital data on how users interface with an organization, particularly online. Over the last decade, social analytics has become a primary form of business intelligence, used to identify, predict, and respond to consumer behavior. It is a tool that analyzes pieces of information gathered from every user’s on line activity. Most website, if not all, uses social analytics tool to monitor and gather information which enables the site owner to analyze trends.<sup>2</sup>

There are two forms of social analytics that have applicability to learning technologies. These are web analytics and social media analytics.

### Web Analytics

Website administrators use a social analytics service to gather and analyze data such as:

- site visits and unique site visits (i.e. unique, independent visitors as opposed to one visitor visiting a site multiple times)

- the pages that are the most and the least viewed
- search terms used to find the site
- physical location of site visitors (city/country) and the time of day that most visitors access the site
- the last page site visitors access before leaving
- web browsers and operating systems that visitors use

The Web Analytics processes in order are: to analyze needs, goals and define metrics; It collects and record data; Then it test improvement strategies and implement; Next is to measure outcome; Last is to repeat process periodically. Below is a snapshot of a web analytics using Google Analytics system.<sup>2</sup>



## Social Media Analytics

This is a tool that measure an organization's 'influence' over different social media. It collects and analyzes data that are related to an organization across various social media sites. Data gathered provides valuable demographic information on who, the organization's market are. It is also used to identify the social media tools that are aiding the company's objectives which in return the company can use to their advantage.



## II. Industry/Business Application of the Technology

Companies that monitor social media can then take action on areas for improvement or to address specific issues with products or services. Social media analytics is thus a key part of a **customer analytics strategy**; it should be leveraged alongside other types of analytics by just about any retail business, since doing so will provide valuable insight on what consumers are saying about a company.

For the vendors of social analytics software they say that it is ready for mass consumption but not everyone is so optimistic. Katie Paine, CEO of consulting firm KDPaine and Partners LLC, says that most of the social media analytics tools now on the market will do a "terrible" job of giving companies a true idea of how the public perceives them. Collecting data is easy, she says, but making heads or tails of it is "extraordinarily difficult" because most of the information is "drivel or irrelevant." Still, sentiment analysis technology has become more capable in recent years, and Angela Chen, director of BI at financial trading firm Liquidnet, said she thinks it has significant potential to help companies if it continues to grow and mature.

Social media analytics adventurers are finding that **commitment and experimentation are the keys to success**. Businesses also should not forget the human-touch side of social media analytics, according to Kumar and others. They warn that sentiment analysis tools aren't very accurate, often failing to pick up on sarcastic or colloquial language.

The most common use for social media analytics tools is crisis aversion. The technology can serve as an early warning system for negative customer feedback, such as complaints about problems with products or customer service. It can also help detect other issues that could be detrimental to a company's image. For example, in 2009 two employees of the Domino's pizza chain filmed themselves violating health-code rules and uploaded the video of their antics to YouTube, where it attracted considerable attention. Done effectively, social media analytics enables organizations to defuse potentially damaging problems before they go viral.

Social media analytics also enables companies to **get unfiltered information from customers about potential product enhancements**. That can be a more effective way of gathering opinions on desired new functionality than surveying customers. Such barriers aren't erected in social networks. And there's a vast universe of customers to tap into: According to an updated report on "social intelligence" that was released in May, 86% of Internet-using adults in the U.S. now use social networks.

But analyzing social media data remains an inexact science, according to industry analysts and consultants. They said that although social media analytics software can provide valuable

information to companies, the results of queries can be skewed because the technology has trouble picking up on tone, slang and nuances such as sarcasm when trying to interpret text data.

## **Social Analytics on Pharmaceutical Industry**

The pharmaceutical industry as a whole has been cautious about its use of social media and mobile technology, but the pace is rapidly picking up, the idea of truly engaging with patients -- beyond the blitzkrieg of direct-to-consumer advertising -- is relatively new. The lack of clear guidelines from the Food and Drug Administration (promised for 2014) is a good reason to tread carefully into social media, but many companies are already beginning to explore the potential benefits.

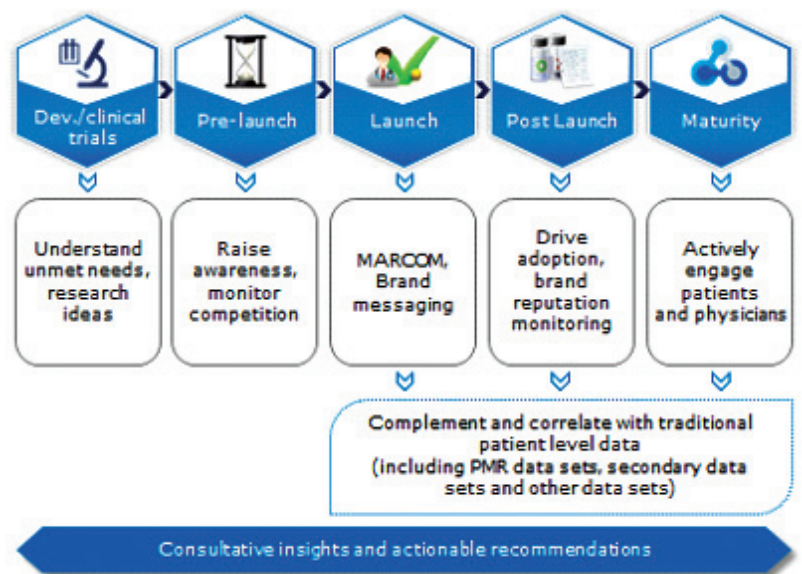
According to a 2012 California Healthcare Foundation and Pew Internet study, nearly 60 percent (60%) of adults looked online for health information within the previous year. Today's social media platforms offer a new avenue of information and dialogue, creating a comfortable (and sometimes anonymous) environment for information exchanges. For pharmaceutical companies, this opens up new opportunities to connect with consumers, to communicate the value proposition throughout a product's lifecycle, and to improve health delivery and outcomes. It sets the foundation to mine information and apply behavioral principles to understand how and why consumers make buying decisions and specific health/lifestyle choices.

Through social analytics they are able to:

- **Monitor conversations** relevant to their brands, industry and competition. Along with a rigorous assessment of current social media activities, this is a key to developing a future strategy and for determining goals focused on measurable return on investment.
- **Conduct forward and backward listening assessments.** With so much noise from online drug sales and other “spam,” it can be difficult to cut through the clutter, but it’s important to monitor relevant conversations both in real-time (forward listening) and historically (backwards listening). By tracing topics for the past year or so, you can create a baseline of social media activity/sentiment for a specific drug or brand.
- **Monitor product/service launches** to gauge reaction and make adjustments if necessary.
- **Compile business/market intelligence reports** to stay one step ahead of the competition.
- **Improve current social media outreach** by identifying key influencers and channels worth engaging. Look for opportunities to be a thought leader or share your expertise without directly promoting a product or brand.
- Improve customer support to increase customer satisfaction levels and improve brand loyalty.

It is critical to adhere to the founding principles of listening and monitoring at all times: ensure truth and accuracy, be transparent, and be respectful of the interests and privacy of patients, caregivers and healthcare providers. And companies must always maintain a strong awareness of the regulatory environment.

That said, social analytics is powerful when launching a new drug. During the research and development phase, a company can review conversations pertaining to similar drugs and/or competitors’ portfolios and develop launch plans accordingly. Companies can also get an aggregated view on pricing, direct consumer experience, demographic segmentation and sentiment of their messages versus their competitors. And once the product launches, direct engagement with consumers, caregivers and healthcare professional can provide a forum for ongoing education and real-time feedback, and may even help improve patient compliance.



## Social Analytics on Financial Industry

Financial services firms are employing knowledge management solutions by using social analytics to break down silos within their organizations that provided better analytics of customer feedback and improved profitability forecasting.

- **More than million connections** - [TD Bank](#) Group, headquartered in Toronto looked at several different solutions, choosing [IBM Connections](#). In less than 6 months, it made more than 1 million connections and forming 3,000 different communities, as well as countless blogs and wikis. TD employees and executives have tightly focused groups, enabling solutions and discussions to be on point which leads to solutions.
- **Enhanced Customer Feedback Analytics (V.O.C. Voice of the Customer)** - [Fidelity Investments](#), a large, diversified financial services company headquartered in Boston, chose platform from [Clarabridge](#). Fidelity, receives hundreds of thousands of pieces of good customer feedback annually from surveys, social media and contact center feedback. It has helped them prioritize improvements in different categories and different services offerings. They expect to expand the use of the Clarabridge application to Fidelity's business-to-business unit, and then to enhance the application with Clarabridge's collaboration capabilities for better teamwork within the company.
- **Improved profitability forecasting** - [PREMIER Bankcard](#) of Sioux Falls, S.D., like other credit card issuers, saw reduced revenue potential with the enactment

of the CARD Act in 2009. Using SAS Forecast Server, it provides more detailed forecasting capability.

- **More time to analyze** – with SAS Forecast Server, analysts are able to spend more time with actual analysis rather than simply writing and adjusting code to develop forecasts. PREMIER Bankcard wanted their analysts, who were spending 80 percent of their time writing macro code and only 20 percent of their time in actual analysis to be able to change that around to only 20 percent of their time writing code and 80 percent in actual analysis.

## III. SWOT Analysis of Industry/Business

### STRENGTHS

- Some Social Media Analytics applications use highly accurate natural – language processing engine to deconstruct and analyze posts captured, going beyond plain language to understand slangs, alternative spellings, often used shortcut terms, common misspelled words.
- It can extract insights and emotions and behaviors can be interpreted by recognizing contexts and goes beyond simple sentiment scoring.
- Some applications provide transparency by giving full access to posts and can get full detail of the actual post if something looks misaligned.

- Helps businesses track and monitor what the customers are saying about the market, products and services, brands and competitors on social media sites.
- Assists businesses to achieve better brand management and greater customer loyalty.
- Improve competitive analysis and insights.<sup>6</sup>

## WEAKNESSES

- There is difficulty in measuring the effectiveness of a content shared if it is only being shared by a very small group of connections in social media.
- In some cases, due to so much data, there is a struggle in relating or connecting the data collected to business outcomes. In order to make this effective, Management must ensure that expected business outcomes are clearly defined.
- An average consumer gets confused with the companies' strategies of these different brands initiating conversations with them online as this resembles advertising or spam.

## OPPORTUNITIES

- There are still some consumers that are not interested in communicating with companies as their main priority in using Social Media is to communicate with friends and family, not companies.
- There is no direct relationship between the consumers and the companies. These relationships are formed between people. That is why it is crucial to empower and

educate individuals to speak on behalf of the company at that personal level.<sup>7</sup>

## THREATS

- Social Media Analytics is not just a way to list and engage potential customers that is thinking about a particular brand. It is still important to aggregate insights and analyze trends in order to engage the right people such as those that can move markets and the company's top influencers.

## IV. Cost-Benefit Analysis

### Cost of Ownership

Cost in social analytics is relative to the scope and duration demanded by the organization. In the Philippines, usually social analytics is being done by a third party agency, seldom, we see companies that do social analytics in an in-house basis. Cost can be presented in different ways. Below are the two cost presentations for Social Analytics.

#### 1. *Cost based on duration of program*

Cost will be relative to the duration of the program. In this scenario, an organization can be charged depending on how long a program will be active or online.

#### 2. *Cost based on per visit/ or per click basis*

Some costs are based on the number of visits or clicks for a certain program. The organization will be billed based on the popularity of the program or how effective the program was in targeting its customers.

## **Benefits of Cost Analysis**

If social media return on investment is difficult to quantify, what are the potential benefits that can be realized by making these investments.

### ***Brand Monitoring***

This includes tracking the compliments, the complaints, when people mention your brand in conversation, video shares, articles, etc before, during and after a campaign and provide a sort of market litmus test for your brand equity in social conversation. This provides insight into how consumers are talking about and engaging with your brand.

### ***Marketing Campaign Effectiveness***

Through these conversations, firms can judge the overall effectiveness of marketing campaigns through direct social feedback.

### ***Crisis Management***

Social media platforms create a rapid fire outlet for customer frustrations and potentially damaging issues that may arise around your brand. Using social media analytics can help companies get in front of any warning signs and respond quickly before something becomes viral that could cause significant damage to your brand.

### ***Strategic Connections***

By monitoring how your brand is mentioned in conversations online, you can also identify and connect with people who have a lot of influence over your potential market. These people are called “influencers” who gain their power through the

number of posts that they make about your brand in blogs, forums, etc., and by how many people share or connect to these posts etc.

### ***Channel/segmentation strategy***

Using social media analytics, firms can also identify current and potential target market segments, distribution channels that may have not been previously considered and watch for trends in consumer preferences and expectations.

### ***Competitive Research***

Social media provides benefits to firms through the ability to monitor what competitor are doing with their brands and what people are saying about them. This sort of competitor you look quickly at the market landscape at keywords that consumers use to describe competitors and adjust your marketing strategies accordingly.

Investing in social media analytics can deliver value to a firm at any level. Although this value may not be easily reconciled to the bottom line, the benefits of doing so are increasingly visible as society becomes more connected and firms should seriously consider the costs of avoidance and the benefits of just jumping on the Social Media Bandwagon.<sup>6</sup>

### ***Financial Analysis***

The metrics you need to evaluate the success of social analytics are specific to your organization. That’s part of the reason why there isn’t just one answer for how and what to measure in social analytics. Each organization has specific, measurable goals and objectives they have to hit. Example business goals are typically:



- Increase brand awareness
- Drive leads in the pipeline
- Drive traffic to website
- Reduce customer service cost
- Improve customer satisfaction
- Improve customer retention and loyalty
- Increase sales

You can apply the SMART Methodology (Specific, Measurable, Actionable, Realistic, and Timed) to social media objectives. Measuring objectives is a way to start. Then you can develop a plan to measure social analytics objectives. Solid measurement programs require testing and evaluating the same data over time. Sharing those results with other departments is also helpful. Most companies are just starting down this path.

*Typical social analytics business goals:*

- Determine what customers and prospects are saying about your company via social media monitoring
- Gather competitive intelligence
- Engage with customers and prospects online
- Build thought leadership through sharing relevant content
- Maximize reach of content and messaging in social channels
- Support existing sales and marketing campaigns
- Support recruiting and retention efforts
- Build a customer community to provide support and advocacy

In most cases social analytics is more of understanding consumer behavior but in order to measure ROI, there is a simple formula that is recommended.

$$\text{ROI} = \frac{\text{Benefits} - \text{Cost} \times 100}{\text{Costs}} = \text{Percentage Return on the Investment}$$

	Google+	Facebook	Twitter	LinkedIn	
Number of Days in Report	30	30	30	30	
<b>Audience and Content</b>					NOTES: This template allows you to calculate the ROI of your social media initiatives. It is designed to get you started and can be extended as required. For example, you might want to split your organic (free) and paid campaigns for more detailed analysis.
Audience	1,000	2,500	4,500	3,000	
Audience Growth	150	500	200	100	
Audience Decline	30	50	80	50	
Posts	30	20	150	15	
<b>Engagement</b>					All values highlighted in blue are automatically calculated based on the white fields.
Social Network Visitors to your Website	90	150	250	50	
<b>Conversions</b>					This report has been developed by Benjamin Mangold, Search & Analytics Director, Loves Data (www.lovesdata.com), a Google Analytics Certified Partner.
Number of Inbound Links to your Website	5	8	20	10	
Total Conversions	1	5	2	1	
Conversion Rate	1.11%	3.33%	0.80%	2.00%	
Value (or Saving)	\$100.00	\$500.00	\$200.00	\$100.00	
Average Conversion Value (or Saving)	\$100.00	\$100.00	\$100.00	\$100.00	
<b>Calculated Value</b>					
Value per Audience Member	\$0.56	\$4.00	\$0.33	\$1.33	
Total Audience Value	\$555.56	\$10,000.00	\$1,500.00	\$4,000.00	
<b>Total ROI</b>					
Ad Spend	\$0.00	\$1,000.00	\$0.00	\$1,500.00	
Hours	3	12	8	3	
Hourly Rate	\$50.00	\$50.00	\$50.00	\$50.00	
Total Investment Cost	\$150.00	\$1,600.00	\$400.00	\$1,650.00	
ROI	270.37%	525.00%	275.00%	142.42%	
<b>Incremental ROI</b>					
Value of Incremental Audience	\$83.33	\$2,000.00	\$66.67	\$133.33	
ROI Based on Audience Growth	-44.44%	25.00%	-83.33%	-91.92%	
<b>*Friends of Friends* Value</b>					
Paid Campaign Reach	-	45,000	15,000	150,000	
Paid Campaign Page Engagement	-	50	200	30	
Paid Campaign Engagement Rate	-	0.11%	1.33%	0.02%	
Organic Friends of Friends	-	300,000	400,000	250,000	
Potential Additional Audience	-	333	5,333	50	
Potential Additional Audience Value	-	\$1,333.33	\$1,777.78	\$66.67	

Benefits is the actual benefit that a customer can get, examples are number of calls, number of customers inside a store, number of serviced customers, number of buying customers, etc. While cost refers to the total cost spent for a particular program.

## V. Ethical Implications

Social analytics have been gaining popularity because of the emergence of technology and social media. This method is already widely used in academic research as well management consulting. Companies such as Google, IBM, Acxiom have developed tools that are offered to provide “actionable knowledge using scalable processes to accommodate expanding database” (Cate, F.H. June 2011, Privacy, Ethics, Analytics) As these technologies continue to develop, annual growth is steadily increasing and demand for new information/research escalates, there is also a need to address several ethical issues that is

related to this new method. One of the ethical challenges in social analytics is that privacy or anonymity is not possible. Researchers have an ability to link the respondents using a network map without the consent of respondents. In using social analytics, similar to typical research, we should be able to get respondents consent on their identity as well as the data we will be getting from them. This can be a major ethical issue because researchers may be able to link and connect relationships and network activities without the respondents knowing that they are being mapped. With social analytics, private data are being shared and compiled in order for organization to gather sufficient data. On some applications right now, like facebook apps created by companies, they are requiring personal data to be encoded and submitted. Data gathered must be kept with confidentiality to avoid leakage of personal data of people involved in social analytics.

Another ethical challenge is that the process of data can be compromised, researchers may not be able to capture the true population of the study. While internet users represent a growing audience, it cannot solely be used to analyze data or monitor consumer behavior. Also, in social analytics, researchers are not able to verify if individuals responding to a certain survey or users being monitored of their network activities are the targeted respondents. Companies should be able to decide on what data to use and validate and independently be confirmed using other research tools; legal, social and cultural factors should be considered in using this tool.

## VI. Nation-Building Implications

**S**ocial Analytics can be both beneficial and detrimental to our society. First, it provides relevant and important information to businesses and industries that help in economic development of our nation. It speeds up gathering data by properly programming what's needed in the system which may give efficient results to business processes. These data can form business strategies and at the same time monitor consumer response. However, confidential information may also be at risk with this system. Since privacy is one of the major concerns of social analytics, it may result to harmful events if abused and mistreated. Information is a very powerful tool in many aspects of our lives, more particularly with businesses that affects the society. It builds network swiftly and precautions are not in place especially to young who do not know how to protect themselves from the malady of technology. If information is not used properly, or interpreted incorrectly, chances are damaging occurrences will be experienced.

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## EMERGING TECHNOLOGY ON BIG DATA



## EMERGING TECHNOLOGY ON BIG DATA

## I. Technology Description

*“Small data is gone. Data is just going to get bigger and bigger and bigger, and people just have to think differently about how they manage it.” – Scott Zucker of Family Dollar.*

There are many factors that contribute to the increasing data volume such as unstructured data from social media, transaction-based data stored over time, sensor or machine to machine data collection and many more. There are data that needs to be analysed or dealt with immediately or in a timely manner. There are also different types of data that also need to be merged and managed. That is why there is a greater need for a bigger collection and storage of these large and highly complex data.

What is Big Data? According to Wikipedia, It is the term for a collection of data sets so large and complex that it becomes difficult to process using on-hand database management tools or traditional data processing applications. Basically Big Data collects, curates, captures, processes and manages data with sizes that are beyond the ability of ordinary or commonly used software at a given time. Gartner analyst Daug Lainey also defined Big Data as assets of high volume, high velocity, and/or high variety information requiring new

forms of processing to enhance decision making and process optimization. What were mentioned above were theoretical definitions of Big Data, but the main question is, how will it affect human life? Can it really change the world?

Big Data is the biggest technological shift today. If before only employees can accumulate data and put it in a processor, now users as well as machines can also do so. If before data is being brought to a processor, now, several processor is being brought to a data. The technologies that drive the Big Data are Hadoop which is an open source platform and organizes a parallel processing infrastructure and the Map Reduced, which is a way of putting a table of contents on each server of a data. It is very evident that today, data accumulation and processing have scaled up and this has a great impact on human lives and the world.

Big data affects human life because it empowers people to answer faster the unanswered old questions before. It allows them to ask new questions and solve new problems that cannot be done before. Big Data is not just about technology but also about business impact because it brings competitive advantage through accumulation of new generation of information. For example is the use of biometric sensors and analytics that can measure and improve a person or an entity's performance. You can also predict blockbuster return when producing a movie. You also have the power to download as many pictures and invite people to look at your online shop through social media.

Yes, Big Data can change the world. Now, we can win over Cancer through accumulation of new generation of information which can be of help

to study or invent a cure for it. Big Data enables the transformation of how a city is monitored and is managed using analytics to predict problems before it happens. In the US, LAPD uses Big Data to predict crime and road accidents. Big Data is the power behind the Rio Operations Centre in Brazil with 560 cameras and 400 employees to monitor railways services, utilities, electricity, gas, emergency services and transportation as well as predict meteorological incidents, car accidents through weather reports. They also use social media to give information to people as to what is happening across the city. Through the use of Big Data, they are able to use advanced analytics to predict problems and deploy appropriate response. These make their city flow better and improve the lives of their people. If this is what can happen from city to city through the Big Data then the world will become a better place.

If there are many positive sides on Big Data, there are also negative sides to this. One is privacy. Millions of people are now inclined to social media, sharing photos, comments and likes. This is dangerous because people may see your profile and know where you live, where you work, what you do. Another is the loss of expertise. Data beats expertise. Being an expert in a certain field goes away because everyone can have access to all the information. Everyone can improve the business or can give a material impact using Big Data and not having to be a PhD or a math geek. These can be negative at some point but if the benefits can outweigh its negative side then it's worth the risk.

There are already a lot of companies who developed Big Data. Teradata is ranked third biggest Big Data vendor in 2012, second is HP. But the biggest Big Data vendor is IBM with revenue of \$1.3 billion in 2012. IBM has a unique platform

that allows you to address the full spectrum of big data business challenges. Whichever company you choose doesn't really matter for as long as it can help us improve our lives and have a better place to live at.

## II. Industry/Business Applications of the Technology

**B**ig data helps companies' pool different kinds of data. It is another technological innovation that results to improved storage and retrieval process of data without compromising the speed and quality of decisions that will be made out of it. It provides immediate assistance to companies having different sources of data such as internet, intranet, or ERP's. Data coming from different departments of the company can be stored as well using Big Data. It integrates data that can be used over a long term period. Nonetheless, it aids to better company performance.

### 1. IBM

- Hadoop-based analytics: Processes and analyzes any data type across commodity server clusters.
- Stream Computing: Drives continuous analysis of massive volumes of streaming data with sub-millisecond response times.
- Data Warehousing: Delivers deep operational insight with advanced in-database analytics.

## 2. Football

- Intel and SAP works together to provide real time statistics to numerous fans, players, coaches, and sports executives.
- “It provides instant player comparisons based on categories such as past performance, weekly matchups, consistency, potential and various intangibles.”

## 3. Centers for Disease Control (CDC)

- Laboratory test results and other medical findings stored in common database helps the doctors trace different types of flu, frequency of infection, and medicines or vaccines prescribed
- “Using that data, the CDC has created complex flu-tracking systems to determine things like: what strains of flu should go in the annual flu vaccine (which is changed twice a year); is this year's flu outbreak the kind of flu that will respond well to anti-viral drugs; how deadly the flu is.”

- The Technology can be used by open source software
- Predictive models can prove to produce higher ROI than without it
- The use of mathematical algorithms makes the predictive models more accurate
- The technology can analyze one entire system and give important information
- Helps minimize all kinds of risks
- Ability to predict non linear outcomes
- Fast data gathering

## 2. Weaknesses

- Human element in assigning values to intangibles might cause error in models
- Longer learning curve for the layman to understand
- Cannot be used using your ordinary desktop because it requires powerful hardware.
- Technology very expensive

# III. SWOT Analysis of Industry or Business

## 1. Strengths

- Analytics of big data technology can integrate predictive models depending on visibility to user
- Ability to make use of unstructured data
- Ability to manage big amounts of data

## 3. Opportunities

- To educate end users further on the use of this emerging technology
- Opportunity to make this technology cheaper and accessible
- Opportunity to predict psychology and human behavior
- Opportunity to develop how it predicts things that happened in the past



## 4. Threats

- Risk of over analyzing scenarios thru this technology
- Dependency to this technology neglecting simple common sense

## IV. Cost-Benefit Analysis

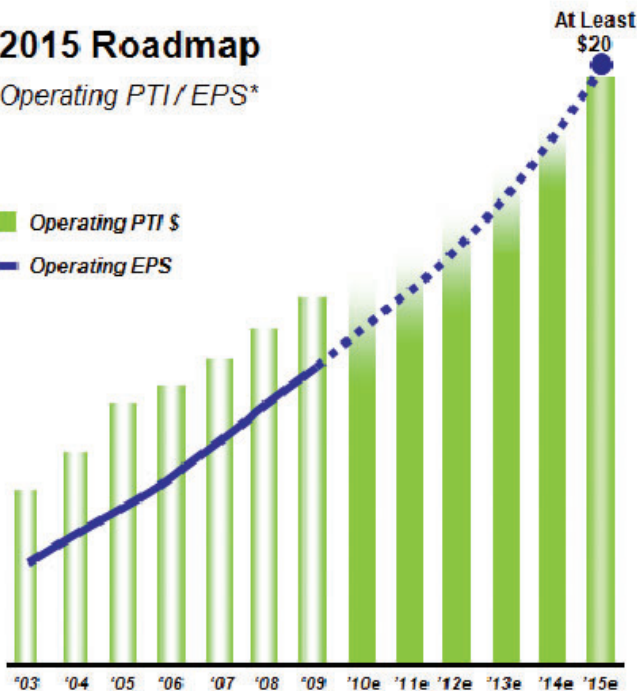
In order to take a look at the cost benefit of Big Data Analytics, we would need to take two perspectives. 1st would be the perspective of IBM, how they make the use of Big Data as a revenue generating service, and 2nd would be how the acquisition of Big Data analytics can help make your business perform better and much more efficient.

Big Data analytics is packaged with IBM's software analysis service and is tailor fit to each potential client. This service is used for management decision making and the identification of process deficiencies. From a cost benefit standpoint, we need to take a look at how IBM creates and packages this service. One of IBM's strategies is to develop technology, package and sell to the client for a premium. These software contracts are Big Data's main source of revenue generation. And from what we've seen is the current driver of IBM's success towards its goals to 2015.

### 2015 Roadmap

Operating PTI/ EPS\*

■ Operating PTI \$  
■ Operating EPS



- Software contributes nearly half of IBM's segment profit
- Growth initiatives deliver \$20B in revenue growth
- Growth markets revenue reaches 25% of IBM's total
- Enterprise productivity delivers another \$8B in gross savings
- IBM generates \$100B in free cash flow, returning 70% to shareholders

Big Data Analytics does not come cheap. A Petabyte cluster used to run these analytics run between 1.5million to 3million USD. As such, the benefits from using this data analytics should provide much higher savings. This is where the ability of management to make decisions against the data is needed in order to drive out inefficiencies in a process and look for savings where waste was identified.

From a strategic point of view, big data ultimately is a tool that can help companies achieve their end goal.

Here are some examples of how big data is making our planet run smarter.

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## Smarter Planet solutions are having an impact around the world



### **Stockholm, Sweden – Smart Transportation**

Congestion charging has reduced traffic by 25% with a 4 year payback on a \$120M investment



### **New York, NY - Smart Cities**

Coordinated Building Inspection and Data Analysis System, Implementing business intelligence technologies including predictive modeling and advanced data analytics, to anticipate fire exposures, analyze possible impacts, and collect and disseminate data on building inspection, permits and violations



### **Rotterdam, Netherlands – Smart Energy, Utility and Environment**

Designing and testing a monitoring and forecasting system for smarter water and energy management  
Exploring with the City additional opportunity areas such as carbon management in logistics processes



### **Dublin, Ireland – Smart Public Transport**

Implementing an integrated IBM back-office system (ticket and smart card management, central reconciliation and settlement services) to all public transport providers



### **Galway Bay, Ireland – Smart Bay**

Deployed a new maritime monitoring solution that collects and disseminates environmental information in near real time to institute staff, researchers, businesses and the public  
Deployed sensor platforms to monitor environmental conditions (e.g., wave height, tidal flow and phytoplankton levels), pollution levels and local marine life throughout the bay



### **Valetta, Malta – A Smart Grid Island**

Replacing all 250,000 analog electricity meters with new smart meters  
Integrating water meters and advanced IT applications to enable remote monitoring, management and meter readings  
Enabling residents to track energy use online and change consumption habits

## A Smarter Planet

### Prime areas to consider for improvement



How much **energy** we waste: 6% to 10% lost because grids are not smart



How gridlocked **transportation** in cities is: \$78B annual loss in U.S. in wasted gas and time



How antiquated our **healthcare** is: no linkage from diagnosis to providers to insurers to employers



How our **water** supply is drying up: 6 fold increase at twice rate of population growth



Inefficiency of our **supply chains**: \$40B annual loss in CPG & Retail industries, 3.5% of sales



Crisis in **financial markets**: inability to track risk has undermined confidence



**“The digital and physical infrastructures of the world are converging. We must make the mundane processes of business, government and life sustainable.”**

Another cost benefit example we can take a look at would be how the Major League Baseball team Oakland Athletics used data analytic programs in order to maximize their roster and improve their win loss record with a slashed budget.

	Oakland A's 2011	Oakland A's 2012
Total Cost Projected	–	1,500,000
Current Payroll	67,000,000	53,000,000
Total Cost	67,000,000	54,500,000
Benefits		
Win Loss Record	22-30	23-9

Given the lack of financial data surrounding the total costs for data analytics service we will postulate that these data analytics equipment would cost around 1.5 million US Dollars, given the median price of these data clusters.

The table is just a simple representation of how the use of big data was restarted by the Oakland Athletics in 2012 and by using their analytics were able to save almost 14 million US dollars in their payroll AND still come up with a winning record.

team	wins	payroll	cost per win	Efficiency
oak	94	\$ 55,372,500	\$ 589,069	51.4%
tampa	90	\$ 64,173,500	\$ 713,039	62.2%
san diego	76	\$ 55,244,700	\$ 726,904	63.4%
pitts	79	\$ 63,431,999	\$ 802,937	70.0%
wash	98	\$ 81,336,143	\$ 829,961	72.4%
kc	72	\$ 60,916,225	\$ 846,059	73.8%
cincy	97	\$ 82,203,616	\$ 847,460	73.9%
balt	93	\$ 81,428,999	\$ 875,581	76.3%
atl	94	\$ 83,309,942	\$ 886,276	77.3%
ariz	81	\$ 74,284,833	\$ 917,097	80.0%
toronto	73	\$ 75,489,200	\$ 1,034,099	90.2%
seat	75	\$ 81,978,100	\$ 1,093,041	95.3%
houst	55	\$ 60,651,000	\$ 1,102,745	96.2%
ladodgers	86	\$ 95,143,575	\$ 1,106,321	96.5%
chicwsox	85	\$ 96,919,500	\$ 1,140,229	99.4%
cleve	68	\$ 78,430,300	\$ 1,153,387	100.6%
milw	83	\$ 97,653,944	\$ 1,176,554	102.6%
color	64	\$ 78,069,571	\$ 1,219,837	106.4%
san fran	94	\$ 117,620,683	\$ 1,251,284	109.1%
stl	88	\$ 110,300,862	\$ 1,253,419	109.3%
nym	74	\$ 93,353,983	\$ 1,261,540	110.0%
tex	93	\$ 120,510,974	\$ 1,295,817	113.0%
minn	66	\$ 94,085,000	\$ 1,425,530	124.3%
chicubs	61	\$	\$	126.1%

By looking at specific averages which lead to success in the baseball field, the Oakland Athletics traded their current rosters and replaced them with players who were a much better fit in terms of efficiency for the team.

Another brief snapshot we can take a look at is how teams in Major League Baseball are efficient in racking up wins.

Big Data Analytics doesn't come cheap. The hardware, software and the skill is so specialized that companies are charging a premium to get this service. However there is endless potential for success, given the fact that information on how businesses, customers and even entire countries operate are now readily available. One thing to note however, is that this type of emerging technology is here to provide businesses with the tools to make an informed decision. Ultimately the success of an organization will lie in the actual interpretation of data and the skill of management to make the right decision for the betterment of the organization.

## VI. Ethical Implications

Like all data storage services, privacy is the main issue for people who use these services. The data storage provider should make sure that all information is confidential and should not be leaked or sold to other parties without consent from the owner of the data. A very common digital crime lately is identity theft. Any person can steal your identity like name, birthday, SSS number, passport number, fingerprints, credit card numbers and any other vital information. This is why big data storage should have the highest security capabilities to protect the public.

In this digital age, those who have access to the most data are kings which is why government agencies like the FBI are monitoring all internet activities in the world to catch spies, terrorists or any information that will threaten the security of the US. At the same time, some governments use these data to spy on people which is a violation of the right to privacy. Professional hackers can also hack the system to steal any information like credit card numbers which allows the hackers to use the stolen credit card numbers for their own use.

A strong digital law should be in place in order to protect the public for misuse of the data as this can easily cause chaos in society. Strong data security is a must for any storage provider as confidentiality and security is the main objective of their business. With the digital law, they can be charged with a criminal offense if they violate it. Strong ethical values should be instilled in this industry as having a lot of information is equivalent to having a lot of power and this entails heavy responsibilities.

## V. Nation-Building Implications

Big Data has truly created a paradigm shift in technology. It has opened new windows on how decision making is made which has not been seen by the world before. In this age, information has never been as essential as before and with the help of Big Data it has created un-biased ways on how to predict things and help make informed decisions in society. But aside from helping businesses grow how can Big Data help build our nation?

Today data gathering has been very essential to improve the services in our country. This has been evident in our advancing government services in traffic management, peace and order, weather and environmental forecasts. Big data has played a big role not only on how they will communicate information to people but also utilize big data in aid of offering better services.

In Traffic Management, the Metro Manila Development Authority has been working with technology and big data in order to improve traffic. It has deployed cameras around the metro in order to act as sensors to give MMDA the data needed to help motorists and commuters with traffic difficulties. Currently MMDA has an Application to determine traffic situations and accidents by using gathered data which will then be communicated to motorists so they can make quick and informed decisions to avoid delay in traffic. The data gathered also serves as tool to detect accidents and traffic faster in order for the MMDA to act upon it quickly. Data also acts as predictors for MMDA on where the accident and traffic prone areas will be.

On the other hand, Weather forecasting is one of the most critical government services in the Philippines. A fast and efficient forecast may save many lives and infrastructures. One of the most popular technologies in the Philippines which uses big data is Project Noah. It gathers information from humans, in which in his case act as the sensors, to be able help the agency to predict and make informed decisions on safety.

Although there are a lot of improvements with the country's technology, it still provides very limited technological resources to our society. Philippines is known to have world class brains when it comes to Information Technology,

however it is not deniable that our Technological Infrastructure is being left behind. According to Anghel De Dios, our IT Infrastructure ranking has dropped from the previous year. This may be critical for us in adapting to the emerging technologies happening in the world like big data. However, this should not stop the government and other sectors on improving their services with the use of Technology. Although Philippines is still not at par with other countries, it should continue to find faster and more efficient ways to improve service

One country which can be a model of technological advancement to us is Rio de Janeiro, Brazil. It boasts a Central Operations Department which offers a centralized command center and caters to big data as their tool to make informed decisions in their community. Big data has offered them solutions from in predicting the weather and even what type of crime will be committed around their town. It helps them make informed decisions about traffic and even health. What's good about their command center is that it is being used to create new systems to improve their society.

In our country there are still a lot of venues to utilize big data, like health care, entertainment, tourism and etc. These venues will create positive changes to help build our nation. But it should also be kept in mind that this emerging technology can build our nation with the help of good governance.

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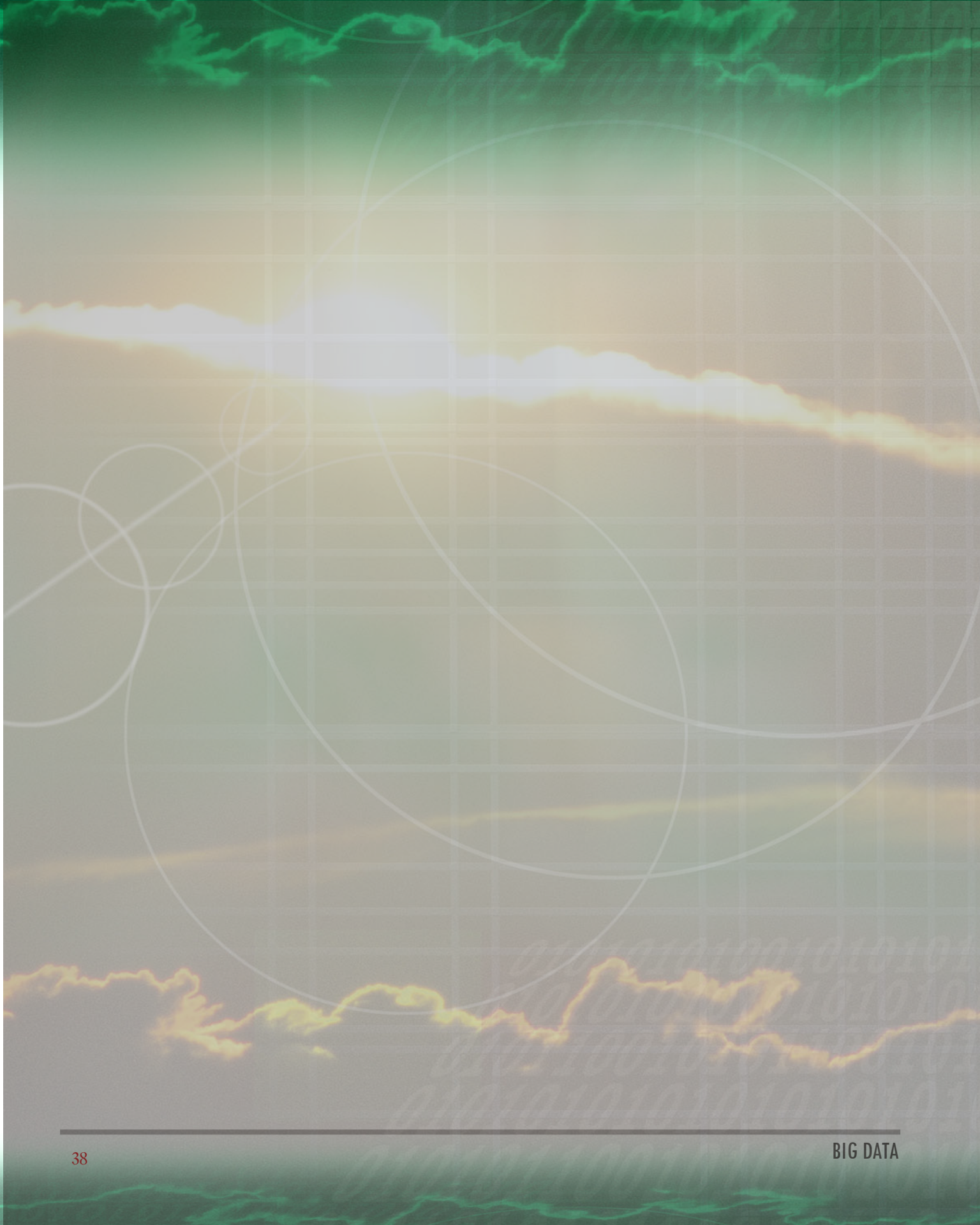
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# EMERGING TECHNOLOGY ON HYBRID CLOUD COMPUTING



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## I. Technology Description

Cloud computing is a terminology used in Information Technology to define a concept of having a large number of computer or computing devices connected through a communication network, more common would be the internet.

The use of the internet is more common as it is publicly accessible without the need of accessing a private network through a secure connection or VPN. Although cloud computing could also refer to a private network which is accessible only by authorized persons or computer within a secure company infrastructure.

Hybrid Cloud refers to a distributed network of computers which are housed or virtualized over the internet as well as devices which are accessible only on a private network. This merges the two concepts in order to afford more flexibility and power to the distributing computing infrastructure. With the combination of one private cloud and at least one public cloud, a hybrid cloud can be offered in one of these three ways:

1. A vendor has a private cloud and partners with a public cloud provider
2. A public cloud provider partners with a vendor that provides private cloud platforms
3. A business already has on-premise software and wants to outsource a cloud-based provider

A hybrid cloud is, more or less, the same as a cloud computing environment, in which a business provides and manages some resources on-premise or in-house but also has others provided externally. For example, a company might use a public cloud service to archive their data but can still continue maintaining in-house storage for operations customer data. The Hybrid approach allows the company to take advantage of the technology's ability to accommodate a growing amount of work or data, as well as the cost-effectiveness that a public cloud computing environment offers.

While public cloud computing does not necessarily need the requirement of having a data center to house the servers, a hybrid cloud still houses servers in a private network while devices which either access or refer to those servers are accessing it over the internet. Virtualized servers housed in public farms can be included into the distributed network and accessed via secure logins either through passwords or device locked access (computers authorized by the network administrators).

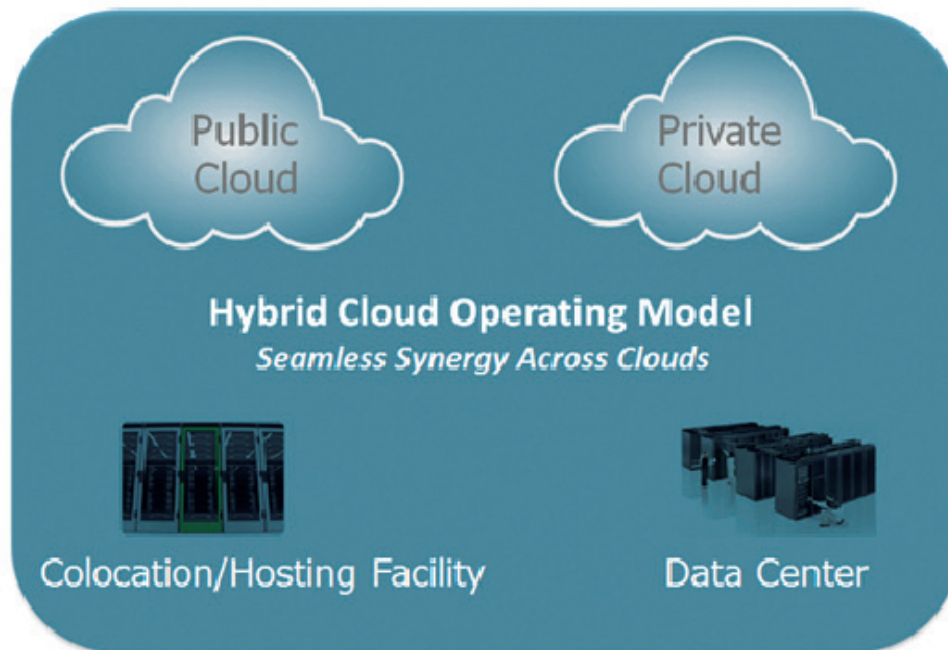
Technically, hybrid clouds are still the most common distributed computing network in use today. This class still requires a data center albeit in a smaller footprint but is still needed to be maintained since equipment and data are not available in the public cloud (i.e. financial, security).

## The real deal of hybrid computing

Hybrid computing technology allows companies to connect the software applications that they run on their own internal servers to applications that run in the cloud. More businesses are gearing towards cloud-based, software-as-a-service (SaaS) solutions because it allows them to reach a broader market and serve customers more efficiently and cost-effectively. However, there are some companies who would prefer to use a combination of both traditional on-premise software and cloud-based SaaS solutions, which makes this cloud computing solution, *hybrid*. This solution is called “the best of both worlds”. It offers high level of security and configurability, that even if it comes with dedicated managed hosting, it also provides instant scalability. It provides a scalable infrastructure on-demand in a cloud network that is 100% virtual and designed to power all of a company’s servers and applications. This platform provides companies significant cost, time and ease-of-use benefits; that is why this is more preferred than the conventional on-premise software.

Streamlining and automating a company’s payments processing is a good illustration to this. A company’s accounting software may not provide a payments processing service that can easily snap into the accounting application. But with the SaaS offerings available from the hybrid computing platform, the company will have a faster running and integration with their core application, which will not require them to purchase another equipment.

Below is a sample illustration of a hybrid cloud computing platform:



## 2. Industry/Business Applications of the Technology

In finance team the chief financial officer and the department has to produce a cash flow forecast for the coming financial year. The chief financial officer carries out the calculation and relevant files are locally saved from his PC and the PC's of his staff. It can happen that not everybody can save the same document and therefore is working with different formulas. And, how does the business came up with an idea? By consolidating the single file used for cash flow forecast by using the internet.

This is where cloud computing comes into the picture. There are mainly three models of cloud computing. A private computing is a cloud infrastructure exclusively used by a single organization comprising business units. In private cloud your data stays in the organization's data center. A public cloud is open for the general public. An example of which is the Dropbox. A Hybrid cloud is composed of two or more features of private and public cloud model. One survey shows that 66% of the companies will use the hybrid solution in four years.

Hybrid solution is a mix of the advantages of both private and public computing. Since the main problem with public computing is security. You may want to put your business process that makes your business unique in your private cloud while your HR department server stays in the public cloud for accessibility of the files. Confidential files in your company are stored in the private cloud so you'll have a close control of it.

Hybrid solution's key distinction is called the virtual private cloud. The company has a data center inside the infrastructure at the same time has a service provider that carries the company's data center which you can access anytime you want. It may also suggest that a company may own a private cloud even without having the cost of owning the infrastructure.

The real strength of hybrid solution is that it combines the elements of traditional IT, private cloud and public cloud. However the challenge of having this solution is the difficulty of having lots of different infrastructures. And this goes to show that the middleware is the key component of hybrid cloud computing.

Middleware's core main function is to provide common interface across applications so no matter where they are installed they appear the same to end-users who also have computers and they expect a consistent result. Middleware cannot however resolve other issues like latency (network problem) and security which requires a multi-layered approach to ensure that data are accessed by the right people and data are protected against unauthorized access.

The challenge of hybrid computing however includes the file location and data organization and regulators are pressured as to where data will be stored in the cloud. There is a need for geographic awareness that is why several companies provide consultancy to help which model is suited for your company.

So a hybrid cloud offers the best of both worlds. You can keep the benefits of private cloud in terms security and personal control and at the same time use public cloud which allows your company to save money.

### 3. SWOT Analysis of Industry/Business

<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>• Ideal solution to load heavy projects which cannot be easily handled by a company's in-house servers</li> <li>• Get access to resources quickly; can be operated anytime</li> <li>• Allows companies to easily expand capacity of their technological infrastructure</li> <li>• Cost-efficient</li> <li>• Faster time to market</li> </ul>	<p><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>• With dependency over local IT infrastructure</li> <li>• Complex networking</li> <li>• Security threats</li> <li>• Compliance is a difficult parameter to achieve hybrid configuration</li> <li>• Resistance from the financial institutions due to data sovereignty</li> </ul>
<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Fast-paced growth of businesses in the Philippines</li> <li>• Gives level playing field to enterprises</li> <li>• Information Technology spending in the Philippines increased by 9.6% in 2012</li> </ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• Data loss / leakage ; abuse or nefarious use of cloud computing</li> <li>• Provider's financial stability</li> <li>• Threat of new entrants</li> </ul>

### 4. Cost-Benefit Analysis

#### A. Cite Total Cost of Ownership (TCO) – Capital Investment, Hidden Costs

Total Cost of Ownership is basically a financial estimate used in order to make an informed decision as to whether the company should invest to a new product/systems or technology, considering its direct and indirect costs. This is called the long-term price because it considers both the initial purchase price of an item plus the costs, which are expected to be incurred in the future.

*The following amounts on the next page are based on the assumption that the technology will be used in the span of 4 years.*

*These amounts reflect estimates coming from a company provider of Cloud Services. The company has created these cost estimates given the assumption that the technology to be given is that of a Hybrid Cloud Computing Service.*

## HYBRID CLOUD COMPUTING

### HARDWARE/SOFTWARE/ PROGRAMS

Cloud Infrastructure (investment)	<b>\$130,000.00</b>
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### OPERATIONS EXPENSES

#### Logistics

*Assumed to be increasing 10% per year (650 per month start up)	Year 1	\$7,800.00	\$36,200.00
	Year 2	\$8,580.00	
	Year 3	\$9,438.00	
	Year 4	\$10,382.00	

#### Colocation

*Assumed to be increasing 10% per year 1500 per month (start up)	Year 1	\$18,000.00	\$83,538.00
	Year 2	\$19,800.00	
	Year 3	\$21,780.00	
	Year 4	\$23,958.00	

#### Bandwidth

*fixed 2500 per month	<b>\$120,000.00</b>
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#### Other Operating Expenses

<b>\$24,000.00</b>
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#### Long Term Expenses

<b>\$4,000.00</b>
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### Total Cost of Ownership

<b><u>\$397,738.00</u></b>
----------------------------

**Cloud Infrastructure** – This amount includes the cost of Server hardware and software, start-up workstations, installation of programs needed, upgrades and patches and the network hardware and software expenses.

**Logistics** – this amount refers to the cost of bringing the product/service to the consumers. The amount is assumed to be increasing by 10% in relation to the potential increase in customers.

**Colocation** – refers to the data center where equipment space and bandwidth are made available for the customers. This cost estimate includes space, power, cooling, and physical security for the server, storage and networking equipment.

The amount reported also includes Infrastructure (floor space), Electricity, Downtime, outage and failure expenses, Security and info tech personnel.

**Bandwidth** – refers to the costs of transferring and maintaining data communication resources from service provider to the consumers.

**Other Operating Expenses** – cost of maintaining the business. Inclusive of this number are the following:

- a. Testing Costs
- b. Technology Trainings
- c. Audit
- d. Insurance and other fixed expenses

**Long Term Expenses** – The Amount includes the cost of replacement of some computer hardware as well as the potential upgrades of the software involved in the operation.

## **B. Cite Direct and Indirect/ Strategic Benefits**

### ***No capital needed?***

One of the more obvious benefits of Cloud computing is that it cancels out the need for businesses to shell out huge amounts of capital to invest in hardware. Instead, they can use Cloud Computing on a usage-payment basis. This is something that is very helpful for smaller companies and in executing different projects. This lets smaller players enter the industry as they can already compete in terms of not having to shell out capital. Also, this is very important for those short-term projects in where you only need the resources for a given amount of time. Why buy the hardware if you can just pay as you use?

With all these being said, companies can leverage on their assets, with Cloud computing. Looking at it on the financial point of view, you have less unused assets. If you only need the resources for specific projects, which aren't really a big part of your business, why invest in the resources when you can just pay for it as you use it?

### ***Accessibility and Mobility***

With accessibility given by Cloud Computing, imagine inputting your data from your home, letting people from half way across the world read the data at once. With the use of the internet today, you can access your information from different sides of the world at the same time. As most of the employees nowadays own a smartphones, with easy access to the internet, it would be really easy to access information from anywhere.

### ***Back up, Recovery, and Continuity!***

As all your data is already on the internet, you won't have to think about the lost data that you have. Let's look at the iCloud that Apple uses on their iPhones. We can see how users are able to store their contacts and photos on the Cloud, without worrying about these files if their phones get destroyed.

It becomes very easy to back-up and to recover files through the Cloud. As we can see today, backup and recovery of files is something very important in data, specially to bigger companies. As companies have been shifting from paper-based documentation to computer-based documentation, it becomes a question: What happens if your hardware is destroyed?

Continuity is also something that is very important to most businesses. As businesses cant skip an hour in a normal course of the business day, as a lot of things may go wrong in an hour, Cloud computing is there to serve as a back-up if something goes wrong with something in the company. Back-up servers can be put in the Cloud.

### ***Safety***

In Cloud computing, security can be made from the users point of view, and from the third party provider's point of view. In this way, security is more than doubled. In Hybrid computing, security is even made better as Private Cloud Computing is used. We can see how private information can be kept private while using the public cloud for information that isn't so private. In this sense, we will, and we will be sure that data will be kept safe.

### 3. Financial Analysis

#### (ROI, Payback Period, Return on Assets, Return on Equity, etc.)

*\*\* We only selected important ratios, which could be used to evaluate investment decisions.*

*\*\* Values are estimates given to us by the Sales Team/Finance Team*

1. **Return on Investment** – this is a profitability indicator, which measures the rate of return of the money invested. The value will give us a picture as to whether the company must undertake the business or not.

$$\begin{aligned}\text{ROI} &= \text{Annual Return/Investment} \\ &= \$ 35,000/\$130,000 \\ &= \mathbf{26.92\%}\end{aligned}$$

- Based on the figures, the hybrid cloud Computing seems to be a good investment because the supposed company can generate more than the quarter of initial investment for at least the first year. Considering that this is just an emerging technology, the prospective business maker can take advantage of the timing of creating the business in order to capture many first time potential clients.
- The higher the ROI the better, because it means that the investment gains compare favorably against investment costs.

2. **Return on Sales** – is a ratio widely used to evaluate an entity's operating performance. It is also known as "operating profit margin" or "operating margin. It is the return achieved from standard operations and does not include unique or one off transactions. ROS is usually expressed as a percentage of sales (revenue).

$$\begin{aligned}\text{ROS} &= \text{Net Income/Net Sales} \\ &= 35,000/58,000 \\ &= \mathbf{39.66\%}\end{aligned}$$

- Amounts used are Annual Figures

The higher the ratio, the better. This means that the company is efficient enough to manage the expenses against the change in Revenue. This ratio is often used to compare industry performance or even company performance (trend Analysis)



3. **Payback Period** – refers to the time before an investment is recovered. It is the time period where the cumulative cash inflow is equal to the cost of investment.

	Net Cash Inflow	Cash to Date	Payback Period
Year 1	36000	36,000	1.00
Year 2	41400	77,400	1.00
Year 3	47610	125,010	1.00
Year 4	54752	179,762	0.09
			<b>3.09</b>

130000.00

\*4990/54752

- The lower the figure the better. The figure means that the company can recover the initial investment in the span of 3.09 years.
  - It is better if the amount is being compared to other technologies to know which one could be the best investment decision. 3.09 years of payback period is pretty good considering that the business is relatively unknown for in the market as of now. The Public is still not aware of the benefits and usage of this business which gives logic to the lengthy recovery period.
4. **Degree of Operating Leverage** – is the leverage ratio that sums up the effect of an amount of operating leverage on the company’s earnings before interests and taxes (EBIT). If the degree of operating leverage is high, it means that the earnings before interest and taxes would be unpredictable for the company, even if all the other factors remain the same.

$$\begin{aligned}
 \text{DOL} &= \% \text{ Change in EBIT} / \% \text{ change in Sales} \\
 &= .04 / .15 \\
 &= \mathbf{.2667}
 \end{aligned}$$

- The higher DOL the better, since the company can make use of its flexibility to dodge financial risks. If the ratio is high, it means that a small change (increase) in sales would result into a bigger movement in Net income.

5. **Profitability Index** – refers to the ratio of discounted benefits over the discounted costs. It is an evaluation of the profitability of an investment and can be compared with the profitability of other similar investments, which are under consideration. The profitability index is also referred to as benefit-cost ratio, cost-benefit ratio, or even capital rationing. The profitability index is one of the numerous ways used to quantify and measure the efficiency of a proposed investment.

If PI is >1 = accept the project

If <1 = Reject the project

$$\begin{aligned}
 \text{PI} &= \text{PV of future Cash Flow/ Initial Investment} \\
 &= 140,159.79/130,000 \\
 &= \mathbf{1.08}
 \end{aligned}$$

	Net Cash Inflow	PV factor	Present Value
Year 1	36000	0.909	32,724.00
Year 2	41400	0.827	34,237.80
Year 3	47610	0.752	35,802.72
Year 4	54752	0.683	37,395.27
			<b>140,159.79</b>

\*\* Assuming 10% interest rate

- With our assumption that the company would operate for 4 years, the Profitability ratio would suggest that the investment is good because the figure of above 1 would suggest that income could be realized within the expected time frame.
- This is a good indicator of financial capability because the PI (profitability index) considers the time value of money (value of money today), which means that the figure above has already included the potential effects of the interest rate.

## 5. Ethical Implications

The ethical implications of hybrid cloud computing arise mainly from client confidentiality or security risks in using the technology, which includes security breaches (i.e. hackers, malware, etc.), risks from careless or disgruntled insiders (resulting in data shared to unauthorized persons) and risks from state surveillance and interception from the legal authorities.

The use of cloud computing has raised ethical concerns of confidentiality, competence, and proper supervision of nonlawyers, according to the Professional Ethics Committee. Cloud computing, by definition, is the use of a third party service provider to store data at a remote location that is also accessible by others outside the law firm.

Lawyers have the obligation to not only keep updated with developments in the law, but also latest technological developments. However, lawyers are advised to be knowledgeable and responsible of the latest technology they use to maintain client confidentiality and to protect client information from being lost or compromised.

*“Lawyers may use cloud services in their practice to promote mobility, flexibility, organization and efficiency,” the Connecticut Bar Association summarized in its opinion. “However, lawyers must be conscientious to comply with the rules that require lawyers to make reasonable efforts to meet their obligations.”*

The use of cloud computing by law firms have been approved by approximately 13 state bar organizations in the United States of America,

provided that steps on “*reasonable care*” is applied which includes:

### 1. Due Diligence before Using Cloud Services

Law firms should consult with computer experts, know the potential risks of the cloud services and identify possible measures accepted by commercial security standards, in order to maintain security and client data confidentiality.

### 2. Establish Appropriate Relationships with Cloud Service Providers

Substantial care should be exercised in selecting a reliable and reputable cloud service provider. A written, fully enforceable service agreement should be used to define all the terms of service, which includes provisions of confidential and proprietary materials.

### 3. Special Care for Extremely Sensitive Material

The most sensitive data, communications and other materials should be identified and evaluated by law firms before storing them in cloud computing systems.

### 4. Continuously Review and Enhance Security Measures

Law firms should have continuous monitoring and evaluation of security measures and activities of their cloud services. They should close work and coordinate with their cloud service provider to ensure maximum security, to anticipate potential security threats and to analyse all security breaches encountered.

## 6. Nation-Building Implications

For nation building, we can only but imagine the potential that Cloud Computing can contribute to a nation.

### *For the Economy*

First of all, in terms of the economy, Cloud Computing is something that can serve as an advantage to us Filipinos. As we may know, Cloud Computing is something that helps us bridge gaps from different areas of the world. As we know that our country is already one of the cheaper, with the you-get-results-for-your-money workforces, Cloud Computing even makes it easier for businesses to use our workforce! As we can see today, even our banks are now trying to get into Hybrid Cloud computing for their operations.

If you also think about it, we can see that it becomes easier for companies to manage their resources through Cloud Computing. For other businesses, these even serves as solutions in cutting their costs, whether it may be from salary costs, to other operational costs. It helps a lot of businesses become more efficient in a lot of ways.

Looking at the people who are hindered to do business because of the size of capital that is also at stake in some industries, we can see that Cloud computing is letting those people rise and up and compete with the bigger players in the industry. We can see here that this will pave more way for those in the middle class to find niches in their particular industries.

### *For Information Dissemination*

As we all know, information is something that is very important to a lot of people. If you look at the fields of medicine, there are different kinds of data, research and information are supposed to be shared to the world at lightning fast speed. Minutes of delay may spell the difference in saving a person's life. Cloud computing has made its foot on the realm of medicine in the aspect that it helps Doctors share information, and even use Cloud computing for things that some hospitals have not invested in.

Information dissemination is not only about sharing information. Through Cloud Computing, people from different parts of the world may edit documents at the same time. Imagine as problems or projects become more complex in a daily basis. Through the use of Cloud computing, different specialists from around the world can share their ideas with each other, and solve different types of problems online, in an instant. One can just imagine the different types of scenarios and industries this can change. Not only information can be shared online, but there are ideas, applications, and best practices that can also be done in different types of situations.

We can only imagine the potential of this when it comes to social media, and in customer feedback for different types of businesses.

### *In Education*

In education, we can see how education is already accessible to anyone with an internet access. Cloud computing helps the students have better access to education. Imagine the problems that we have today of having classrooms that are too small, having too little teachers willing to

become teachers. These can be solved through the use of cloud computing in making virtual classrooms with teachers that can teach even from across the world. You can only imagine the impact of this on the cost savings for schools, and how Cloud computing can also save a lot on expenses for the schools.

If you think about how a student can look at Cloud, is that it can guarantee him/her education wherever he is, with an internet source, but it doesn't stop there. Not only the school can use Cloud computing, but also the students too. As we can see how IT students have had problems when it comes to investments when it comes to finding resources for the servers they test their programs in, cloud computing can be something for them to use.

### ***For the Government***

As sharing information is something that we can see is very important, as we can see in the case of Napoles, one of the things that the people want to see is transparency from the government. We can see that Cloud computing can help in making sure that there is transparency in making information open for everyone. We can see how we can leverage on cloud computing in different areas of our government, specially on the operations side of things.

Overall, we can really see how Cloud computing has been a very important tool today. It has been helping different types of users from across the world today. Whether it maybe in operational efficiencies when it comes to their businesses, or for smaller players in the IT industry to leverage on. We can only imagine the help that it can really do to our community. As it can be used in different types of industries, and in different ways, we can see how things can be better managed through the use of Cloud computing. This is something that can really revolutionize our world today.

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[https://www.floridabar.org/\\_85256AA9005B9F25.nsf/0/9DA5423ABE78318685257B0100535ADD?OpenDocument](https://www.floridabar.org/_85256AA9005B9F25.nsf/0/9DA5423ABE78318685257B0100535ADD?OpenDocument)

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## GROUP 5

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EMERGING TECHNOLOGY ON  
3D BIOPRINTING



EMERGING TECHNOLOGY ON  
3D BIOPRINTING

# EMERGING TECHNOLOGY ON 3D BIOPRINTING

## I. Technology Description

3D printing is the process of creating a 3D object from a digital model by using additive manufacturing, in which an object is made by adding material layer by layer and fusing it together. This approach contrasts with traditional manufacturing, in which an object is formed by removing excess material. Before there was 3D bio printing, there was first the traditional 3D printing whereby from a digital model, successive layers of material such as plastic, ceramics, glass or metal is laid down to print an object. Three dimensional solid objects are made out of the digital model that has been designed.

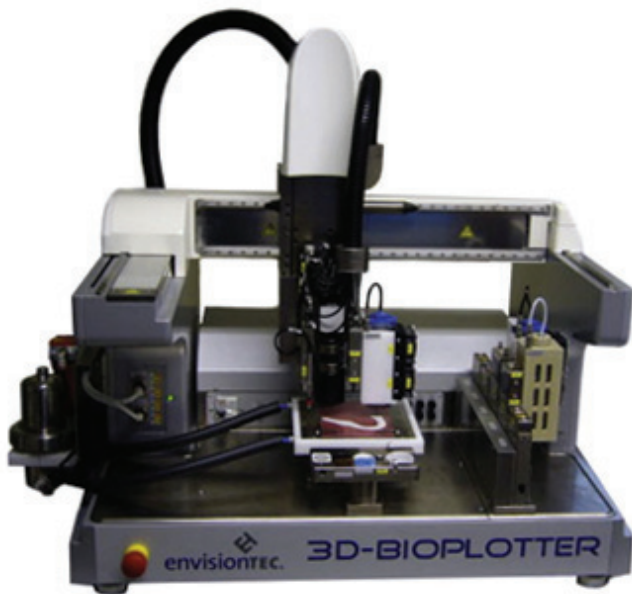


Figure 1. Example of a 3D - Bioprinter<sup>1</sup>

3D printing is increasingly permitting the direct digital manufacture (DDM) of a wide variety of plastic and metal items. While this in itself may trigger a manufacturing revolution, far more startling is the recent development of bio-printers. These artificially construct living tissue by outputting layer upon layer of living cells. Currently, all bio-printers are experimental. However, in the future, bio-printers could revolutionize medical practice as yet another element of the New Industrial Convergence<sup>2</sup>. Bio-ink is a cocktail manufactured from living cells and used for printing purposes. Stem cells are cells that are able to replicate themselves many times and can also turn into other specialised cells. Once the cells have multiplied to sufficient numbers these liquid cell suspensions are housed in what are basically printing cartridges called bio-cartridges<sup>3</sup>. The cells remain in suspension in the cartridges until they are sprayed out along with another cartridge filled with a liquid matrix material, at which time they all bind together with the help of various proteins and biological factors. Printing is done on a bio-paper; this paper slowly dissolves as the layers of ink bind and start to take on the shape of human tissue<sup>4</sup>.

<sup>1</sup>ExplainingTheFuture.com: Bioprinting. (n.d.). ExplainingTheFuture.com by Christopher Barnatt. Retrieved September 21, 2013, from <http://www.explainingthefuture.com/bioprinting.html>

<sup>2</sup>Ibid.

<sup>3</sup>Ibid.

<sup>4</sup>Ibid.



## Bioprinting Pioneers

Several experimental bio-printers have already been built. For example, Professor Makoto Nakamura realized in 2002 that the droplets of ink in a standard inkjet printer are about the same size as human cells. He therefore decided to adapt the technology, and by 2008 had created a working bioprinter that can print out bio-tubing similar to a blood vessel. In time, Professor Nakamura hopes to be able to print entire replacement human organs ready for transplant.<sup>5</sup>

Another bio-printing pioneer is the company Organovo. This company was set up by a research group lead by professor Gabor Forgacs of the University of Missouri. In March 2008, it managed to bio-print functional blood vessels and cardiac tissue using cells obtained from a chicken. Their work relied on a prototype bio-printer with three print heads<sup>6</sup>. The first two of these output cardiac and endothelial cells, while the third dispensed a collagen scaffold (which is now termed 'bio-paper') is to support the cells during printing<sup>7</sup>.

Since 2008, Organovo has worked with a company called Invetech to create a commercial bio-printer called the NovoGen MMX. This bio-printer is loaded with bio-ink spheroids that contain an aggregate of tens of thousands of cells. To create its output, the NovoGen first lays down a single layer of a water-based bio-paper made from collagen, gelatin or other hydrogels. Bio-ink spheroids are then injected into this water-based material. As illustrated below, more layers are subsequently added to build up the final object. Amazingly, nature then takes over and the bio-ink spheroids slowly fuse together. As this occurs, the bio-paper dissolves away or is otherwise removed, thereby leaving a final bio-printed body part or tissue.<sup>8</sup>

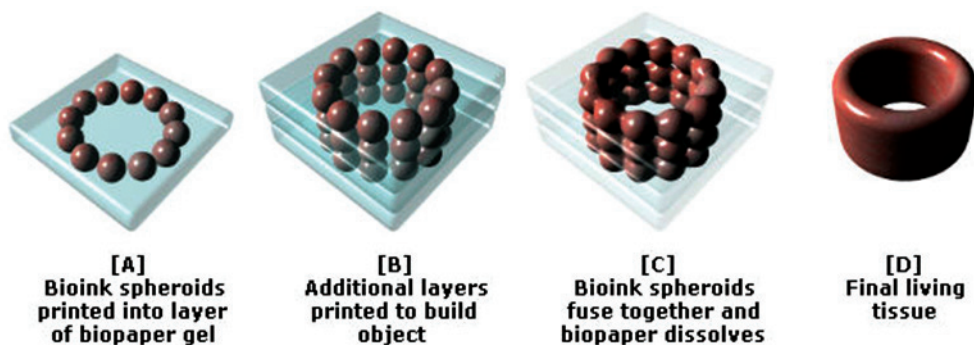


Figure 2. Process of 3D - Bioprinting

<sup>5</sup>Ibid.

<sup>6</sup>Ibid.

<sup>7</sup>Ibid.

<sup>8</sup>Ibid.

<sup>9</sup>Ibid.

## II. Industry/Business Applications of the Technology

**B**io printing is mostly directed towards improvement in the healthcare sector, transforming the methods of practicing medicine.

One of which is regenerative medicine. Bio-ink developments began with skin regeneration in repairing burns and small skin laceration<sup>10</sup>. The technology since then has advanced to also incorporate bone and muscle. Medical researchers hope to be able to use the printed tissue to make organs for organ replacement. This will cut down organ donor waiting lists to zero, as well as making skin grafts a thing of the past. Since bio printers print from a culture of a patient's own cells, organ failures in need of an organ replacement will be replaced by a replica of the patient's own grown organ thus minimizing the risk of organ rejection.<sup>11</sup> Aside from internal organs, direct printing on an external wound or even inside the body using keyhole surgery technique, called in vivo is already being developed.<sup>12</sup>

Bio-printing is also playing a part in how pharmaceutical companies conduct medical

research. Pharmaceutical companies have been using 2D cell cultures to test drugs, however these 2D structures do not reflect human tissue as 3D does thus may produce misleading results.<sup>13</sup> Testing with 3D tissues, however, provide more precise results, which allows for pharmaceutical companies to determine failed drugs early on before investing more money in development.<sup>14</sup> In addition, this lessens the requirement for animal experimentation of their developed drugs. The technology has the potential to save the drug companies a lot of money because it could cut drug testing costs. Less wasted money and time for pharmaceutical companies. Drugs make it to the market a lot faster.

Aside from healthcare, it is also paying a part in the food production and sustainability sector. 3D bio printing has also been associated with production of raw meat. In attempt to address the food shortage problem we might we faced with in the future scientists like Gabor Forgacs of Organovo suggests engineered meat with the technology of bio printing.<sup>15</sup> It does away with the resource intensive way of obtaining meat. Printed meat is not artificial since it comes from the same meat cells as meat obtained from the butchering process. Food sourcing can become a lot animal friendly.

<sup>10</sup>BioScaffold - Engineered Scaffold For Tissue Engineering - Bio Ink. (n.d.).BioScaffold - Engineered Scaffold For Tissue Engineering - Home. Retrieved September 22, 2013, from <http://www.bioscaffold.com/Bio-Ink.html>

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<sup>15</sup>Moskvitch, K. (n.d.). BBC News - Modern Meadow aims to print raw meat using bioprinter. BBC - Homepage. Retrieved September 22, 2013, from <http://www.bbc.co.uk/news/technology-20972018>

### III. SWOT Analysis

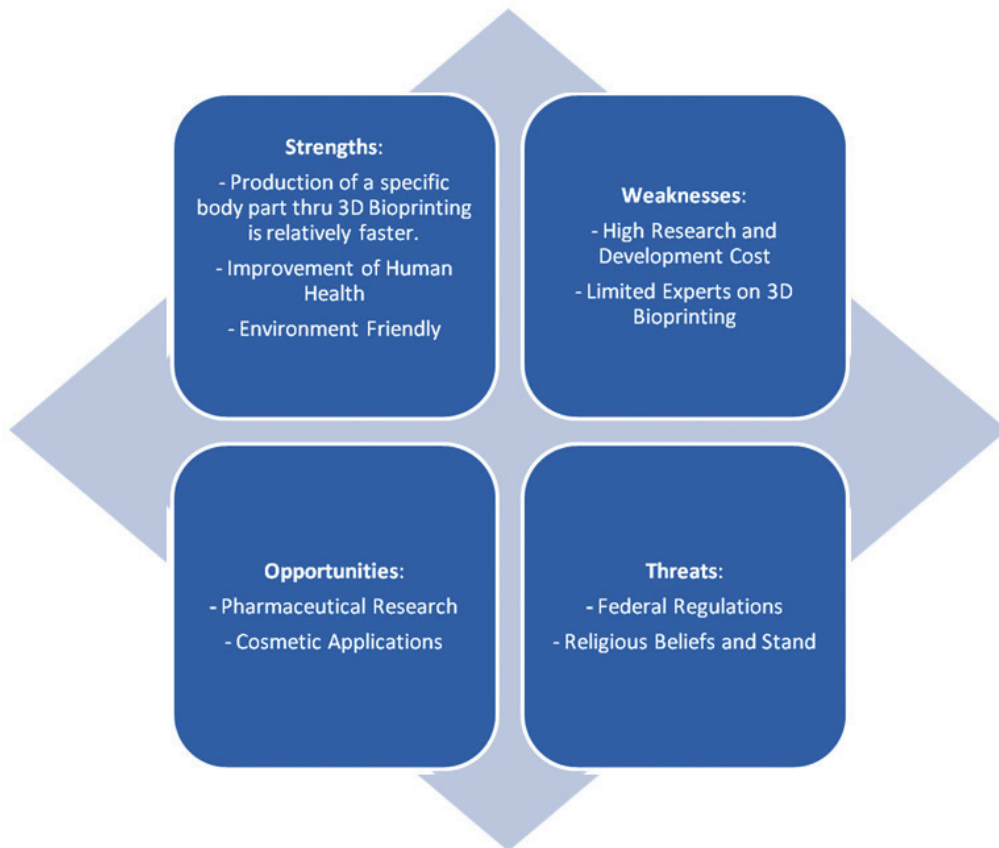



Figure 3. SWOT Matrix

#### Strengths

*Production of a specific body part thru 3D Bioprinting is relatively faster.*

Compared to waiting for a possible organ donor which may usually take months or even years to get a match and finally get a successful organ transplant.

Sixty years ago, scientists were on the cusp of a revolutionary scientific breakthrough. In the preceding decades, researchers had some success transplanting organs in animals, and there had even been a few failed attempts at human organ transplants. Numerous studies showed that human organ transplantation was feasible, and that it would be enormously beneficial to thousands of patients, but nobody had been able to make it work.



Success finally came in the early 1950s, when several kidney transplants within a few years gave new life to ailing patients. In the following decades, doctors learned how to transplant other organs successfully, and they dramatically improved recovery rates. Today, most organ transplants are relatively safe, routine procedures, and transplantation is considered to be the best treatment option for thousands of patients every year.

Unfortunately, doctors and patients now face a new obstacle: The demand for transplants has far surpassed the supply of donated organs. Simply put, there aren't enough organ donors, so patients must wait months, even years, for their chance at recovery.<sup>16</sup>

With the introduction of 3D bioprinting years of waiting will be a thing of the past. It would be perceived that it would only take weeks to have an organ or a body part ready to be implanted. Scientists initially tested it on printing an ear cartilage.

“The process is fast,” Dr. Bonassar says. “It takes half a day to design the mold, a day or so to print it, 30 minutes to inject the gel and we can remove the ear 15 minutes later. We trim the ear and then let it culture for several days in a nourishing cell culture medium before it is implanted.” During the three-month observation period, the cartilage in the ears grew to replace the collagen scaffold. “Eventually the bioengineered ear contains only

auricular cartilage, just like a real ear,” says Dr. Spector.<sup>17</sup>

With 3D Bioprinting, a patient waiting for an organ would not have to wait for years, many of which die before they receive the matched organ, it would only take them several weeks and the organ is ready for transplant.

### ***Improvement of Human Health***

Patients requiring organ transplant would suffer from excruciating pain and the danger of dying if they will not be transplanted with the organ needed. With the advancement of 3D Bioprinting, patients quality of life will definitely improve.

Today, while most things that are 3D printed are made from plastics or metals, already there are specialist 3D printers that can build up living tissue by laying down layer-after-layer of living cells. Such ‘bioprinters’ have the potential to transform many areas of medicine by allowing replacement skin and human organs to be 3D printed from a culture of a patient’s own cells. If this happens – and bioprinting pioneers expect that it will within two decades – then the development of 3D printing may cut organ donor waiting lists to zero, as well as making skin grafts a thing of the past. In as little as five years, 3D printed tissues may also start to be used in drug testing, so lessening the requirement for animal experimentation. In addition to 3D printing replacement human tissues outside of the body, in vivo bioprinting is already

<sup>16</sup>Harris, T. (n.d.). HowStuffWorks "How Organ Transplants Work". HowStuffWorks "Science". Retrieved September 23, 2013, from <http://science.howstuffworks.com/life/human-biology/organ-transplant.htm>

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in development. This involves 3D printing layers of cultured cells directly onto a wound, or even inside the body using keyhole surgery techniques. Should this kind of technology become advanced enough, one day instruments may be able to be inserted into a patient that will remove damaged cells and replace them with new ones. Such instruments may even be able to repair the wound created by their own insertion on their way out. While such hypothesis may sound fantastical, some medical practitioners and 3D printing pioneers are already taking them very seriously indeed.<sup>18</sup> With this advancement on its way, the possibilities are endless, chronic pain syndrome or congestive heart failure would be a thing of the past. Defective part of the body can easily be replaced by health and functional cells which will make quality of life better. Danger of organ rejection would not be experienced anymore since cells will be coming from the patient's own unlike if it were from a different donor.

### ***Environment Friendly***

Technology advancement is usually indirectly proportional to environmental preservation. With the vast improvement in technology, major issues need to be addressed when it comes to environment protection. However there is no environmental threat with 3D Bioprinting as it uses environment friendly material which is known as the “Bio Ink”. This is yet another kind of environment friendly ink that is considered as durable as solvent inks.

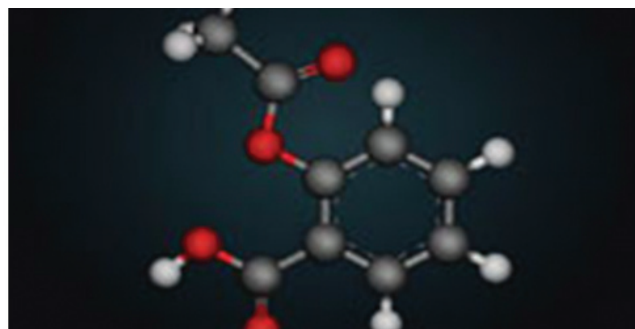


Figure 4. Bio Ink molecular structure

Bio-ink is a kind of liquid or ink which is manufactured from living cells and then the ink is used for printing purposes. These inks are formulated with ingredients which are biodegradable. 90% of these materials are biodegradable which makes the ink environmentally safe for printing. Bio-ink can also be prepared from cotton, corn and wood pulp and this renders the ink as 80-85% renewable. They do not compromise on the quality of the print and thus it yields great printing quality. Bio-inks make use of similar pigments that are found in solvent inks, same printer and the printed material is similar to the one when solvent based inks are used.

Bio-inks are durable, bond to uncoated surfaces and they come in a wide range of attractive and vibrant colors. The bio-ink produced from cottonseed oil gives high color strength with good rubresistance. This can be used on a wide range of boards and papers and can be used without alcohol. Bio-ink is not very well known today and it comprises of less than 0.5 percent of the market. But, it is yet another ink which cares for the environment by releasing very low VOCs and hence due to this Wal-Mart have now switched to bio-inks for printing on their products.<sup>19</sup>

<sup>18</sup>ExplainingTheFuture.com : 3D Printing - The Next Industrial Revolution. (n.d.).ExplainingTheFuture.com by Christopher Barnatt. Retrieved September 22, 2013, from [http://explainingthefuture.com/3dp\\_book.html](http://explainingthefuture.com/3dp_book.html)

<sup>19</sup>Eco Friendly Inks.(n.d.).The Big Green Print. Retrieved September 21, 2013, from [www.thebiggreenprint.com/eco-friendly-inks/bio-ink.html](http://www.thebiggreenprint.com/eco-friendly-inks/bio-ink.html)

## Weaknesses

### *High Research and Development Cost*

Since 3D printing is still in its developmental stage, there is a huge need for funds to be able to sustain research and development for this product. Currently there is only one company that is engaged in the development of 3D Bioprinting and that is Organovo. It has said that they are currently operating at a loss due to the vast amount needed to sustain the development of the product. Though potential for this product is huge most companies have not partnered or maximized the potential of this product since they have yet to produce a viable product that have been utilized to a live patient. Organovo spends about \$15.2 million of funding to further research bio printing and requires financial help of investors and donors as well.

### *Limited Experts on 3D Bioprinting*

There are a lot of experts such as engineers, architects and scientists to conceptualize and create a 3D printer however creating a 3D Bioprinting is different, it would need not just experts from engineering and architecture but this also would need inputs from Medical Doctors and specialists. The development of the technology would need experts from all these fields as evidenced by the example below.

Scientists tried to replicate the meniscus – a C shaped cartilage which cushions the knee and other joints. Although the first meniscus looked promising, when this was showed to knee-replacement surgeons, they deemed it too weak to withstand the body's routine abuse. "As somewhat of an outsider coming in [to biology], Lipson's

impression was 'Okay, I'm gonna put the cells in the right place, incubate it for a while, and we're gonna have our meniscus,'" Lipson says. "There is more to making a meniscus than just putting the cells there. Real menisci are actually pounded every day, all the time, and they shape up and become stiff. So the pounding that's in their environment is actually very much a part of their growth." The meniscus needs to be redesigned in such a way that it could be used by the real human being.<sup>20</sup>

## Opportunities

### *Pharmaceutical Research*

Bio-printing is also playing a part in how some pharmaceutical companies conduct medical research, and the technology may also have the potential to save the drug companies a lot of money because it could cut drug testing costs, Chen said.

Medical researchers in the pharmaceutical industry, until lately, have used two-dimensional cell cultures to test drugs during the early stages of development. However, the 2D cell cultures do not reflect human tissue as accurately as 3D printed tissue, meaning the 2D models can create misleading test results.

Testing with 3D tissues, however, provide more precise results, which allows for pharmaceutical companies to determine failed drugs early on before investing more money in development.

And with clinical trials accounting for the largest percentage of the biopharmaceutical industry's budget for the research and development at \$31.3 billion, according to a report from the

<sup>20</sup>How 3 D Printing Body Parts will Revolutionize. (n.d.).Popsci. Retrieved September 21, 2013, from [www.popsci.com/science/article/2013-07/how-3-d-printing-body-parts-will-revolutionize](http://www.popsci.com/science/article/2013-07/how-3-d-printing-body-parts-will-revolutionize)

Presidents Council on Science and Technology, it's no surprise that drug companies want to use 3D tissues to help avoid wasted costs.

*"It's very, very significant...It takes a lot of time and money developing a successful drug," Chen said. "I think this is a great idea and will save the pharmaceutical industry a lot of troubles ... It could help get drugs to market faster."* And this is where Organovo sees opportunity, Renard said.

Organovo, with the help of the Australian company Invetech, was the first company to launch a commercial 3D bioprinter. The company originally intended to sell its printer, which is called the NovoGen MMX bio-printer, to other companies for use. But after seeing opportunity to cash in on the market for human tissue, the company changed its business model to making tissues for drug companies for medical research and therapeutic applications instead.

"Generally, the drug business can benefit significantly from these 3D tissues... There's plenty of evidence that their processes are basically broken. They are inefficient and highly suspect," Renard said. "There's a big problem and they are looking for a better solution."

Organovo, which trades on the OTC market, wants to be that solution.<sup>21</sup> With technology being developed, this would have pharmaceutical companies save a lot on research, now they would not need actual human beings to serve as test patients, the company would just request for

specific parts print it out using 3D Bioprinting and aim the research towards it.

### ***Cosmetic Applications***

Along with allowing keyhole bio-printers to repair organs inside a patient during an operation, in situ bio-printing could have cosmetic applications: for example, face printers. Face printers would evaporate existing flesh while simultaneously replacing it with new cells to exact patient specifications. People could therefore download a face scan from the Internet and have it applied to their heads. Alternatively, some teenagers may have their own face scanned, then reapplied every few years to achieve the appearance of perpetual youth.

The idea of having the cells of your face slowly burnt away by a laser and reprinted to order may sound like a nightmare that nobody would ever choose to endure. However, as we all know, many people today go under the knife to achieve far less cosmetically. When the technology is available to create them, face printers – let alone printers capable of printing new muscles without the hassle of exercise – are very likely to find a market.<sup>22</sup>

## **Threats**

### ***Federal Regulations***

With all the advancements to come from 3d bioprinting, the impact it will have on humanity will surely be great. Along with all these changes society and social structures will also have to adjust to the new factor of 3D bioprinting. Medically

<sup>21</sup>How 3D Printers Are Reshaping Medicine. (n.d.).Stock Market News, Business News, Financial, Earnings, World Markets - CNBC. Retrieved September 21, 2013, from <http://www.cnbc.com/id/49348354>

<sup>22</sup>3D Bioprinting.(n.d.).Fung Institute for Engineering Leadership. Retrieved September 21, 2013, from [www.funginstitute.berkeley.edu/sites/default/files/3D\\_Bio-Printing.pdf](http://www.funginstitute.berkeley.edu/sites/default/files/3D_Bio-Printing.pdf)

things would need to be approved by countries respective regulatory boards like the FDA for the United States of America for example. They are the ones who promote and protect the public health of people in America. As such, they would have to approve every procedure involving 3D printing and this could be a problem in the progress of the technology as a bottleneck appears and limits will be set on what type of procedures will be allowed.<sup>23</sup> So even if the procedure is a possible option, if it is not FDA approved it will not be allowed in some areas and this may reduce funding on the procedure. This will also affect the sports industry regarding performance enhancements. The governing bodies in sports must regulate what may be a method of rehabilitation or an enhancement in an individual athlete's ability to perform in his/her respective sport.

### ***Religious Beliefs and Stand***

One of the threats in 3D Bioprinting would be the disagreement from different religious sects. The Catholic church which make up a big chunk of the population in the world is against anything or any act that manipulate human life in any way.

When it comes to human beings the Catholic church is against alteration of what has been made by God. Because we have rational souls and immortal spirits unlike the plants and animals our dignity and position in creation is infinitely higher. Man has no right to usurp the position of God concerning human sexuality and reproduction particularly when it comes to manipulating these laws unnaturally and artificially. Therefore, it is not permitted to use artificial birth control because it frustrates the very reason for the sexual

act as God intended it. In like manner it is not permitted according to the natural law to separate the functions of human sexuality and negate the other essential reason for sexual activity and that is the full expression of spiritual unity by the act of physical union.

Therefore, even when science has the ability to fertilize a human egg in a petri-dish with the sperm of the woman's husband and then attempt to implant it within the uterus of the egg's own mother it is totally against the natural law and a complete frustration of the will of God regarding the very nature of human sexuality. Both the procreative and unitive elements must be present for human sexuality to be authentic and according to God's intention.<sup>24</sup>

3D Bioprinting would also fall into the category of human manipulation of the life that has been given by the creator and therefore would cause major religious sects to stop this modern advancement.

## **IV. Cost - Benefit Analysis**

The direct financial benefit from 3d bioprinter has not been properly established. Currently, the objective of the company that distributes the bioprinter is to make the technology available to researchers in order to make tissue and organ printing a reality. In order to understand the financial potential of 3d Bioprinting, we will be using the blueprint of one of the pioneering company in the bioprinting industry, Organovo.

<sup>23</sup>Ibid

<sup>24</sup>Cloning and the Catholic Church.(n.d.). Roman Catholic Replies. Retrieved September 21, 2013, from <http://www.roman-catholic.com/Roman/Articles/Cloning1.htm>



Organovo, with the help of the Australian company Invetech, was the first company to launch a commercial 3D bioprinter. The company originally intended to sell its printer, which is called the NovoGen MMX bio-printer, to other companies for use. But after seeing opportunity to cash in on the market for human tissue, the company changed its business model to making tissues for drug companies for medical research and therapeutic applications instead.

Organovo was incorporated in 2007 and have only a limited operating history. Therefore, there is limited historical financial information upon which to base an evaluation of the performance and future prospects. Future prospects must be considered in light of the uncertainties, risks, expenses, and difficulties frequently encountered by companies in their early stages of operations and competing in new and rapidly developing technology areas. Organovo have generated operating losses since they began operations, including \$4.0 million for the three months ended March 31, 2013 and \$9.3 million, \$2.3 million and \$1.2 million for the years ended December 31, 2012, 2011 and 2010, respectively. As of March 31, 2013, they have incurred cumulative operating losses of \$17.7 million and cumulative net losses totalling \$66.4 million. Ability to generate revenue and achieve profitability will depend on, among other things, successfully developing drug discovery and biological research tools and products that are more effective than existing technologies; entering into collaborative relationships with strategic partners; obtaining any necessary regulatory approval for our drug discovery, biological research and therapeutic tools and products; entering into successful manufacturing, sales, and marketing arrangements; and raising sufficient funds to finance its activities and business plan.<sup>25</sup>

Hence, the revenue and development stream of the industry is most likely depicted in the figure below.

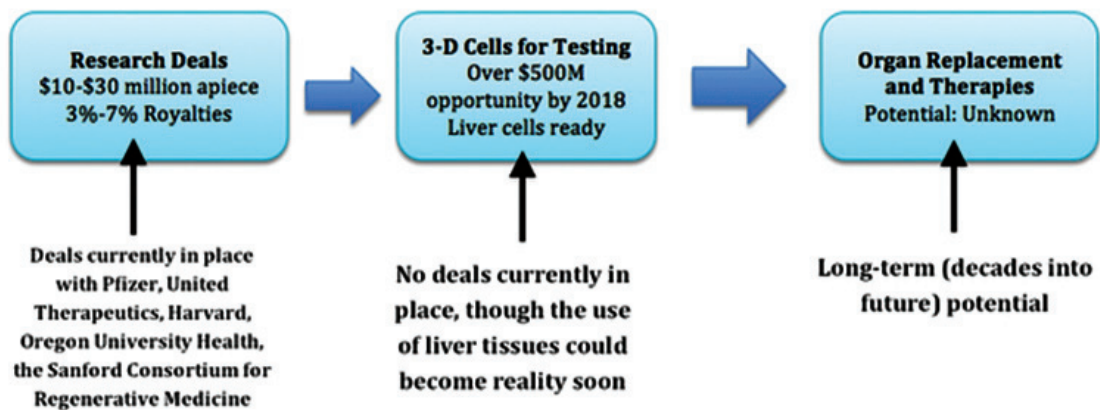


Figure 5. Revenue and development stream of 3D Bioprinting<sup>26</sup>

<sup>25</sup>Organovo Annual Report.(n.d.).Organovo. Retrieved September 21, 2013, from [www.organovo.com/sites/default/files/assets/pdfs/Organovo%20Annual%20Report%202013.pdf](http://www.organovo.com/sites/default/files/assets/pdfs/Organovo%20Annual%20Report%202013.pdf)

<sup>26</sup>How Big Is Organovo's Market Opportunity?By Brian Stoffel. <http://www.fool.com/investing/general/2013/08/23/how-big-is-organovos-market-opportunity.aspx>. Accessed September 20, 2013

Market research firm Scientia Advisors sees a specific market opportunity of more than \$500 million for Organovo by 2018. Currently, the company has functional liver tissues developed, but it hopes to expand to kidney and heart cells.

Organovo would earn its keep by manufacturing the cells and providing them to the drug companies. Along the way, it hopes to continue partnering with drug companies and academic institutions to expand the number of organ cells it offers. Specifically, Organovo is looking for collaboration deals worth between \$10 million and \$30 million, where the company could have a 3% to 7% royalty.

At the same time, the company sees the possibility of developing tissues for therapy. When that time comes, Organovo will expand its scope to include lung, bone, and blood vessels.

## Total Cost of Ownership

The total cost of ownership for a 3D bioprinter has to consider the obvious costs and hidden costs. The obvious costs are the printer and the inks. On the otherhand, the hidden costs are operating costs, the infrastructure support costs, the environmental impact costs, the insurance costs, and the security costs.

The obvious cost of a 3D bioprinter estimated is \$200,000<sup>27</sup> and the Bio-ink, which is taken from the embryonic stem cells, is around \$55,500<sup>28</sup>. The hidden cost of operations is from the salary of \$35,493 per cell tissue researcher. Asides from the salary, they also considered the energy cost of the facility. Automation can operate 24 hours a day 7 days a week similar to stem cells. According to the design of facility, there will be 30-40%<sup>29</sup> energy usage for both laboratory and building.

The infrastructure support and training costs are also considered where the Invetech will provide assistance to Organovo regarding the use of the 3D bioprinter. The Organovo must also monitor their environmental impact costs such as the waste disposal. They should either recycle or properly dispose waste products.

Every company should have insurances for their employees, buildings and clients. Organovo should covered life insurance of at least \$250,000<sup>30</sup> and also provided medical insurance of \$441 per month<sup>31</sup> and a property insurance plan. And lastly, for security purpose, they should have security guards, CCTV cameras and also security software, offsite data backup, and recovery system.

<sup>27</sup>EnvisionTEC sells 3D Bio-Printer under 200K - Nanalyze. (n.d.).Nalyze - Investing in tomorrow's disruptive technologies today. Retrieved September 21, 2013, from <http://www.nalyze.com/2013/08/envisiontec-sells-3d-bio-printer-under-200k/>

<sup>28</sup>Predicting costs of stem-cell transplantation. [J ClinOncol. 2000] - PubMed - NCBI. (n.d.).National Center for Biotechnology Information. Retrieved September 21, 2013, from <http://www.ncbi.nlm.nih.gov/pubmed/10623694>

<sup>29</sup>Griffiths, T., Peto, A., Thorogood, J., Tiffany, D., &Michalakis, O. (n.d.).Conceptual Design of a Cutting Edge Stem Cell Research Facility.University of Leeds Faculty of Engineering. Retrieved September 21, 2013, from [www.engineering.leeds.ac.uk/e-engineering/documents/Griffiths\\_et\\_al\\_for\\_publication.pdf](http://www.engineering.leeds.ac.uk/e-engineering/documents/Griffiths_et_al_for_publication.pdf)

<sup>30</sup>Insurance Life Level Term.(n.d.).United States Automobile Association. Retrieved September 20, 2013, from [https://www.usaa.com/inet/pages/insurance\\_life\\_level\\_term?akredirect=true](https://www.usaa.com/inet/pages/insurance_life_level_term?akredirect=true)

<sup>31</sup>Medicare 2013 costs at a glance | Medicare.gov.(n.d.). Medicare.gov: the official U.S. government site for Medicare. Retrieved September 21, 2013, from <http://www.medicare.gov/your-medicare-costs/costs-at-a-glance/costs-at-a-glance.html#collapse-4808>

## V. Ethical Implications

The advancement of technology of 3D bio-printing would certainly raise a few ethical questions. The first concerns would be the sources of stem cells used in a given technique. Most 3D bio-printing protocols use iPS cells but not all researchers follow the same procedures. Some uses adult stem cells, which are morally legitimate. However, others use stem cells derived from destroying human embryos. This is the case, for example, with research at Heriot-Watt University in Edinburgh, Scotland, where researchers have developed a bio-printer that uses human embryonic stem cells as its “ink.” Hence, the ethical implications of 3D bio-printing must be considered if it will serve the purpose of making it widely available and accepted by the public.

Ethical principles may be applied in discerning the ethical issues involved in 3D bio-printing. Utilitarianism is one ethical principle that considers an act is right if it will benefit the greatest number of people. It is inevitable that this new technology may be subject to certain abuses. Organs printed may be sold to the black market or it may be mass produced which may result into organs becoming a commodity. In addition, further research is still needed to prove that this new technology would prove that it is safe and would benefit the public.

However, advocating this new technology may possibly benefit more people in the future. For example, 3D bio-printing can increase life expectancy through coming up with treatments for

diseases, sever injuries, and organ transplants. It can also be the solution for world hunger as there is a possibility for application on printing of food. As it has the possibility of benefitting more people, the ethical implications under the Utilitarian framework would have it to be ethical.

Another ethical principle that may help in determining the ethical implications of this new technology would be about rights. It is important to know the ultimate purpose of having this new technology. It is believe that through 3D printing it would further propel the field of medicine and would change the world’s view on life. Hence, it is important that the purpose of this technology must focus on the interest of the public and not advancing one’s own interest.

In addition, the principles of justice and fairness must also be considered for the ethical implications. Specifically, distributive justice is a principle wherein individuals who are similar in all respects relevant to the kind of treatment in question should be given similar benefits and burdens. At first, the technology of 3D printing may not be readily available to everyone. Further research and test must be conducted in order to ensure the quality and safety of this technology. On the other hand, as the research progress it is possible that this technology can become accessible to the public especially to the poor. Hence, 3D bio-printing should qualify the principle of distributive justice in address some ethical concerns.

On the other hand, if virtue ethics would be applied for this case, it would raise some ethical problems. As mentioned earlier, certain techniques

<sup>32</sup>Brugger, C. (n.d.). Printers Aren't Just For Homework Anymore: The Science and Ethics of Bioprinting | Culture of Life Foundation. Culture of Life Foundation | Complex moral issues made simple. Retrieved September 22, 2013, from <http://www.culture-of-life.org/e-brief/printers-arent-just-homework-anymore-science-and-ethics-bioprinting>

and procedures in printing may become immoral if it destroys life through harvesting of fetuses for embryonic stem cells needed for printing.

Finally, the virtue of care can be one of the driving factors in supporting such technology. We should care for those with whom we are concretely related by attending to their particular needs, values, desires, well-being as seen from their own personal perspective, and by responding to these needs, values, desires, well-being, especially of those who are vulnerable and dependent on our care.

## VI. Nation-Building Implications

Nation-building refers to the process of constructing or structuring a national identity using the power of the state. This process aims at the unification of the people or peoples within the state so that it remains politically stable and viable in the long run.

This new technology of 3D bio-printing must conform to the standards of society. This new technology should also lead to the betterment of the society. The most compelling argument for 3D Bioprinting in terms of Nation-Building is its potential for the massive advancement in medical


technology. By providing alternate ways on acquiring important organs (for organ transplants or skin grafts), it has the potential to make these accessible to the less fortunate in the future, paving the way for universality of treatment and a better life expectancy for all.

As is stated above, it also has the potential to provide alternate means on producing food, with printing of meat and such a possibility of such technology. In fact, just recently in a much publicized public eating in London, the first lab grown beef from stem cells was cooked and eaten in front of the world.<sup>33</sup> If done correctly, this has the potential to provide food to the whole world's population and "end" world hunger. In the Philippine context, with a lot of people living under the poverty line, this technology can help the government in providing for these people, provided the technology has already reached its saturation and is cheaper to implement.

One of the major negative implications of 3D printing, in general, is the potential to disrupt economies. Because of the efficiency and less complexity of 3D printing, it is becoming cheaper and less risky for potential investors to enter the manufacturing industry.<sup>34</sup> As it lessens the barrier for new entry, threats to existing industries will increase. Another implication is the singular automation of what used to be products of different industries. This can lead to the crash of certain industries and massive layoffs.

<sup>33</sup>Wang, S. S. (n.d.). Scientists Cook Up Lab-Grown Beef in London - WSJ.com. The Wall Street Journal - Breaking News, Business, Financial and Economic News, World News & Video - Wall Street Journal - Wsj.com. Retrieved September 22, 2013, from <http://online.wsj.com/article/SB10001424127887323420604578650194180347284.html>

<sup>34</sup>How 3-D Printing Could Disrupt the Economy of the Future - Bloomberg. (n.d.).Bloomberg - Business, Financial & Economic News, Stock Quotes. Retrieved September 22, 2013, from <http://www.bloomberg.com/news/2013-05-14/how-3-d-printing-could-disrupt-the-economy-of-the-future.html>



In much the same way, as 3D Bioprinting as the potential to print food in the future, the food industry, especially the agricultural industry, may be at risk of becoming irrelevant. Jobs relating to food production may become obsolete. This will have a massive effect on the livelihood of millions of people around the world and may exacerbate poverty.

Are the positive effects of 3D bioprinting greater than its perceived negative effects? At this point of the technology, we are unsure as most of the effects described above are intelligent assumptions. Only time can tell the positive and negative effects of 3D bioprinting, although if the intentions are good, the technology has the massive potential to uplift the human condition.

