Materializing the Digital-3D Printing amidst IoT
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Decades have been spent digitizing the material assets and its time now for the reverse!! Let's materialize the digital!! Yes, most of the universal phenomenon is cyclic. Let's observe one more cycle in action and see how its profound 'Effect' affects humanity.

Welcome to the world of 3D Printing amidst IoT, powered by SMAC, where the virtual digital world meets the physical, offering limitless possibilities and shrinks the space, reduces the time and gets you the material assets you desire, CLOSE AT HAND and when YOU WANT!!

This Article is an examination of the opportunities offered by 3D printing in the connected world of IoT powered by SMAC and how their intersection opens up diverse avenues for the business to serve the customer better*. It also focuses on various intertwining factors an Enterprise and the enabling IT must consider to effectively manage this intersection and exploit the opportunities this offers to the fullest potential to deliver superior customer service.

Introduction

Case 1: You are back from work exhausted late that evening, after a hectic day, facing busy Chennai traffic. Suddenly you remember your little daughter's birthday tomorrow and your promise of that beautiful custom made Barbie doll her cousin in New Jersey, USA had. The doll is unique and customizable as per the buyer’s specifications and your daughter has already specified hers. A sinking feeling overcomes you, fearing that this may be a promise that you may not keep. You tweet about your predicament to your US cousin and lo and behold!! you get a call from a US vendor asking for your daughter's specifications and promising delivery in an hour. That's IMPOSSIBLE!! An hour for a doll from US to Chennai having all your daughter's customizations? You ACCEPT. An hour later, the doorbell rings, a cheerful lady is at the door with a box housing YOUR Barbie!!! The next day your daughter rewards you with a WONDERFUL SMILE and a GREAT HUG!!

You KEPT your PROMISE!!! That was magic!!!

Case 2: You are a doctor in a Chennai hospital. There is an emergency!! An outbreak of a lethal virus there and you have an urgent need for a few hundred gas masks. There is a shortage of stock and the supplies are running out. It is critical that the virus be contained and people be protected using masks. You know it takes at least a day to get the masks transported in from a faraway factory in Pune and this is a lead time you cannot afford now. It's a CRISIS!! You SOS from your mobile on your professional network, and in minutes a mask vendor reaches you and promises a hundred masks in the next couple of hours followed by a drip feed of more. You can't believe it!! You say OK!! In a couple of hours a few hundred masks arrive and the drip feeding starts. The virus is contained!!

You SAVED lives!! That was magic!!!

*Please note that this does not dwell on the engineering aspects of 3D Printing
Case 3: You are a General and your troops are stationed at an army base far away from your country in the middle of a war!! There has been an unprecedented sudden snowfall which you are unprepared for. You need special boots for your soldiers and you need them fast to advance. Getting them flown in such huge numbers is going to take a while and this transportation time can have a HUGE cost in the outcome. You call up your headquarters and explain your predicament. They ask you to be prepared and promise you boots in a few hours. You can’t believe it!! HOW?? It arrives as said and your men march forward!!

You PROTECTED your country!! That was magic!!

Welcome to the world of 3D printing, amidst IoT, powered by SMAC. This is where the virtual digital world meets the physical and shrinks the space, reduces the time and gets you the material assets you desire CLOSE AT HAND and most importantly WHEN YOU WANT!!

So let’s first understand what 3D Printing, IoT and SMAC is all about.

- Courtesy Wikipedia

3D Printing
3D printing or additive manufacturing (AM) is a primarily additive process, in which successive layers of material are laid down under computer control. These objects can be of almost any shape or geometry, and are produced from a 3D model or other electronic data source. A 3D printer is a type of industrial robot.

3D printable models may be created with a computer aided design package or via 3D scanner. The manual modeling process of preparing geometric data for 3D computer graphics is similar to plastic arts such as sculpting. 3D scanning is a process of analyzing and collecting digital data on the shape and appearance of a real object. Based on this data, three-dimensional models of the scanned object can then be produced.

Internet of Things (IoT)
The Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications (M2M) and covers a variety of protocols, domains, and applications.

SMAC
SMAC is the collaboration of the disruptive innovations of Social, Mobile, Analytics and Cloud technologies.
3D Printing amidst IoT – Revisiting Space, Time and Matter Equation

Let’s examine the above 3 cases and see the cycle of ‘digitizing’ and its reverse 'materializing' in action in the connected world of IoT, powered by SMAC.

Now let us consider the 3 cases above.

The SMAC forces in play helped in the identification of a potential business opportunity and determined the optimal logistics.

A core product model of the material asset was digitized and what was transported was the design, or digitized form of asset, in a medium, Internet, which shrinks spaces between countries and continents into minutes if not seconds.

This resulted in what could have been a travel of a material asset between 2 continents, to just a distribution from a 3D Printer near the point of demand to its final destination (i.e.) manufacturing happened in proximity to the point of demand and shipping time was drastically reduced.

Also it was easier and less expensive to customize the end product, as the customization was incorporated in the digitized version, and that controlled and created the final material asset for consumption.

So yes, 3D Printing in the world of IoT does change the dynamics of TIME, SPACE and MATTER equation, whereby it transports the MATTER in its digitized form across huge spaces and reduces, if not eliminates the time for shipping.
3D Printing amidst IoT – How Enterprises can exploit these!

- **Product Manufacture**
  1. **Reduced fabrication time**
     As objects are 3D Printed from a digitized version by mostly additive manufacturing, it is quicker to 3D print objects as physical casts and assembly lines need not be created and used. Rapid prototyping aids further in reducing manufacturing time.
  
  2. **Ease of creating complex models**
     As it is easy to create complex models of digital designs in comparison to physical models due to engineering limitations, 3D complex digital designs are initially created. These complex designs can then be 3D printed and translated easily to physical models by printing additive layers of the raw material.

     Scientists are working on bio printing – 3D printing body parts – prosthetics and even human organs in the healthcare industry.

- **Product Distribution**
  1. **Reduced transportation time – Improved logistics**
     As products are 3D Printed from digital designs, and this can be done at 3D Printers close to the point of demand, transportation time/cost can be greatly reduced.

     In the future, there could be a paradigm shift, where 3D Printers become easily affordable and all the enterprises would be shipping would be digital designs which could be 3D printed right in the customer’s home.

- **Product Customization/Refinement**
  1. **Improved user personalization**
     Imagine having the ability to design your car’s exterior, a new design of spoiler, or door handles of course in line with certain core product design.

     Or say creating your own spectacles, clothing or jewelry just by trying out the customized digitized version in augmented reality of your selfie and then materializing the digitized version.

     What a level of user personalization it would offer!!

  2. **‘ON THE FLY’ Product refinements**
     After the launch of a new product, social networks and other customer feedback forums could be monitored for customer feedback and any valid customer improvements or refinements suggested could be incorporated in the digital design, and the refined product can now be 3D Printed.
In fact the enterprises could aim for a ‘ON THE FLY’ product refinement whereby suggested customer feedback refinements could be incorporated in the digital design, sent for approval from the customer and once agreed, the refined digitized design could be 3D Printed to get the refined product incorporating customer feedback.

**SMAC powering 3D Printing amidst IoT – How enabling IT can help**

We have examined how 3D printing, amidst IoT, can be a huge business differentiator and help the enterprises take customer service and user personalization to an elevated plane. Now let us examine how the collaboration of the Social, Mobile, Analytics and Cloud forces can power 3D Printing, amidst IoT and help the enterprises.

**Social:**
- Social Networks can help creation of a connected SOCIAL 3D Printing network
- It can be a marketing arena where the suppliers advertise their designs and track customer preferences and their feedback
- It could be a platform where 3D Printing designs are exchanged

**Mobile:**
- Mobile aids logistics optimization by inferring proximity to the nearest 3D Printer using location based services in a supply chain
- It also aids utilizing augmented reality, with the help of a plethora of sensors, to provide improved user personalization services to create customized digital designs, which can then be materialized
- It enables ubiquitous connectivity and aids transmission and reception of 3D Printing designs on the move – imagine being able to design a brooch or bracelet during your idle time in a train and getting it delivered before you get back home!!!
Analytics:
- Capture and Storage of BIG DATA from Social, Mobile and Cloud networks to aid analytics of improved logistics especially in a supply chain
- Capture of product feedback suggestions and analytics to translate these to ‘ON THE FLY’ product refinements
- Next generation 3D Printing, where sensors could be printed in the material assets, and these could be streaming in information, which could be analyzed and proactive measures undertaken

Cloud:
- Provision of 3D Printing as a service on the Cloud
- Provision of 3D Scanning as a service on the Cloud
- Provision of 3D Digital design customization as a service on the Cloud
- Aid creation of a network of uniquely identifiable connected 3D Printers across geographies to enable quicker distribution across the globe

How enabling IT can help

Connectivity:
- Creating mechanisms for addressing and uniquely identifying the 3D Printers on the network and routing/administering trafficking between them
- Establishing connectivity across 3D Printers in a HUB across geographies and creating a backbone for global distribution

Security:
- Improved security mechanisms and establishing secure protocols for digital asset transmission and storage

Licensing:
- Devising mechanisms to protect the IP rights of the suppliers and police creation of only LICENSED material assets from the digital versions
- Identifying and establishing various, security measures like digital signatures, that could be incorporated in the digital designs and finally embellished in the finished material product to prevent forgery and 3D Printing from illegitimate counterfeit and malicious suppliers

User Personalization – Mobile/Online Applications:
- Develop software for creation of the digital assets - correlation between the physical and the digital
- Develop software for the ‘ON THE FLY’ translation of the user refinement suggestions to digital customizations on the core digital model
Future – Where are we heading??

An age where majority 3D Printing can be affordably carried out at home and all that needs to be sold are the digitized designs.

- Where digitized designs would be the most prized assets – banks have to re-think of collateral and risks as assets which are never there!!
- Where shipping is reduced if not eliminated
- Where Oil prices take a nose dive - due to local manufacturing with reduced shipping and transportation
- Where licenses are sold instead of goods
- Where personalization is taken to a different plane – ease of digital customization
- Where customer feedback is incorporated on the fly as product refinements - ease of digital customization

Though 3D Printing is still in its adolescence, it is slowly but surely maturing. But when it does mature and offer us unbounded opportunities are we READY to exploit it?? Surely we cannot afford to be left behind!!!

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