“Testing the Viability of a 3D Workflow Using Only Adobe Creative Cloud”

Matthew D. Oakes
Graphic Communication Major
College of Liberal Arts

California Polytechnic State University

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ABSTRACT

"Testing the Viability of a 3D Workflow Using Only Adobe Creative Cloud"

Matthew D. Oakes
Graphic Communication - August 2016
Advisor: Dr. Kenneth Macro

To determine whether or not a design team or individual designer can create 3D prototypes and the subsequent finished product in a more economically sound and timely manner by purchasing and utilizing Adobe Creative Cloud applications as opposed to the standard workflow that has been established in the past 20-25 years.

A 15-question qualitative survey was submitted to twenty (20) 3D product designers/engineers that currently work in the established industry. Questions were asked to determine what the standard industry professionals are using in their 3D design workflows and if they are open to newer methods that are becoming available through Adobe's Creative Cloud.

Additionally, I conducted a personal study of the 3D Tools that Adobe has launched in their newest version of Creative Cloud in order to give my input on whether or not a beginner can learn how to design 3D prototypes and enter into the industry with these skills.

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CHAPTER I: INTRODUCTION

Statement of Project

Rapid prototyping has been used for some time in the creation of parts and products for a multitude of industries. In the past, there was no choice but to have a particular set of software packages to design 2D artwork and then have these images handed off to another team that would use them to make final 3D models. Some third-party software packages, made by Autodesk, SolidWorks and others are sophisticated, but have complicated workflows. Their workflows require plugins that are necessary for swapping files back and forth, sometimes converting formats in the process. Only then, are you able to finally have files output to physical objects.

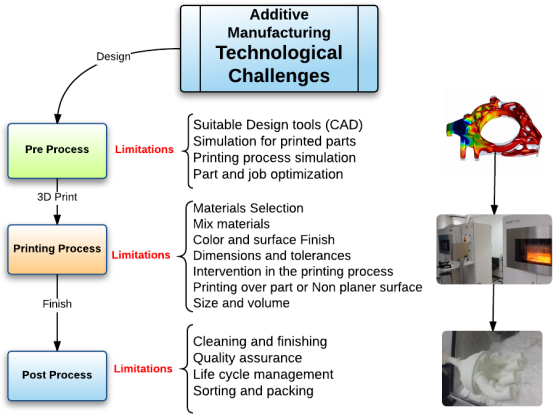


Fig. 1 - Sample 3D Workflow
Source: displaystatesen.blogspot.com

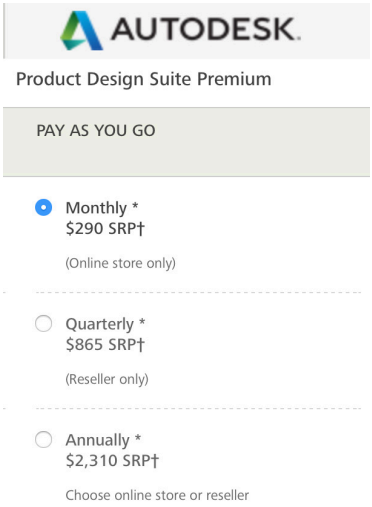


Fig. 2 - A Higher Priced Competitor
Source: autodesk.com

Nowadays, this drawn-out process is unnecessary, as the new technology has given the opportunity to unify the process of 2D and 3D design. A design team, or independent designer, can work very efficiently and quickly get the final product into the hands of consumers. Potentially, this smoother workflow can be achieved by working with Adobe Creative software applications. In addition to working smoothly, Adobe allows designers to purchase or license all their necessary software at a significantly lower price-point. Competitive 3D software companies charge a significant amount for each individual application.

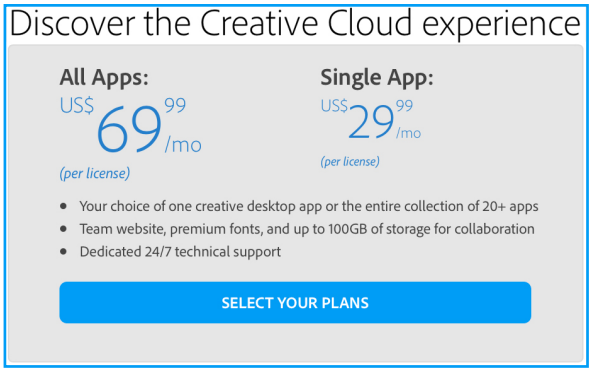


Fig. 3 - Low-Cost Adobe Pricing
Source: creative.adobe.com/plans

Fig. 4 - Stratasys and Adobe Collaboration
Source: stratasys.com

It was my purpose to investigate the possibility of a streamlined workflow that cuts costs, reduces the learning curve, and removes software incompatibilities by using only applications that are part of Adobe Creative Cloud.

Significance of Project

Choosing Adobe Creative Cloud for your entire 3D design workflow can benefit large manufacturing businesses, small startup companies, and solo 3D designers. The initial benefit is the low cost of acquiring Adobe's software. This positively affects a company's bottom-line, but also makes it easy for the beginner to get their business up and running.

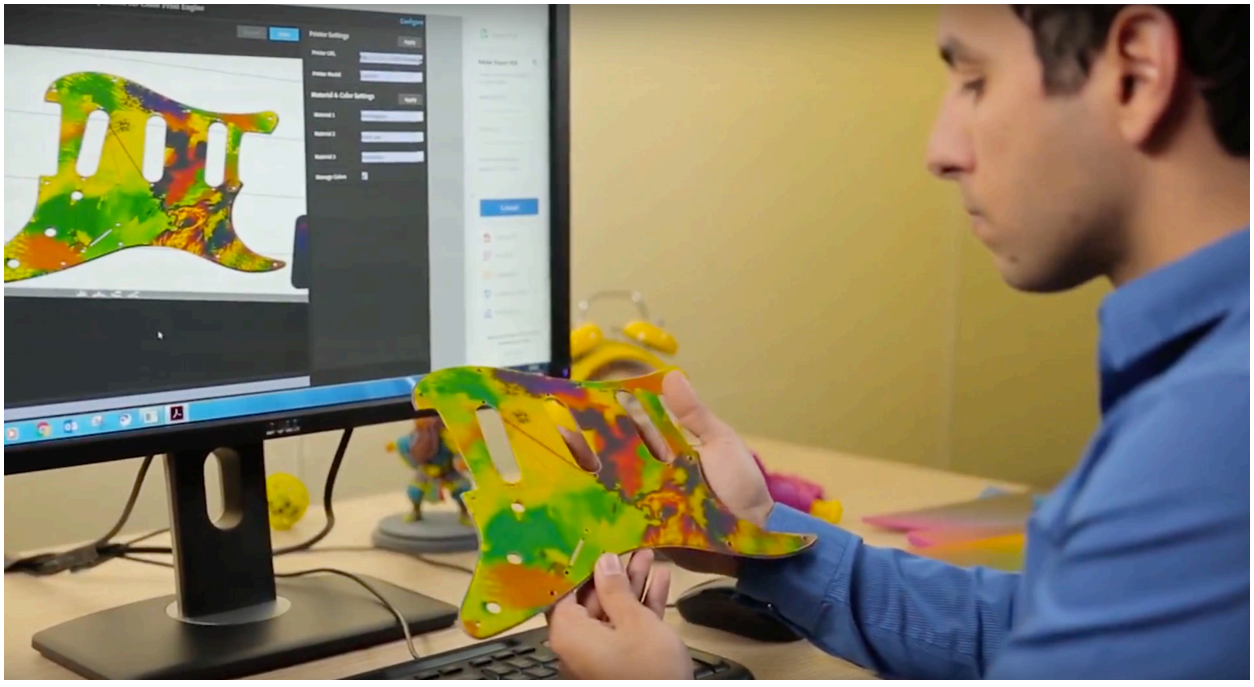


Fig. 5 - 2D and 3D Integrated with Adobe Software
Source: businesswire.com

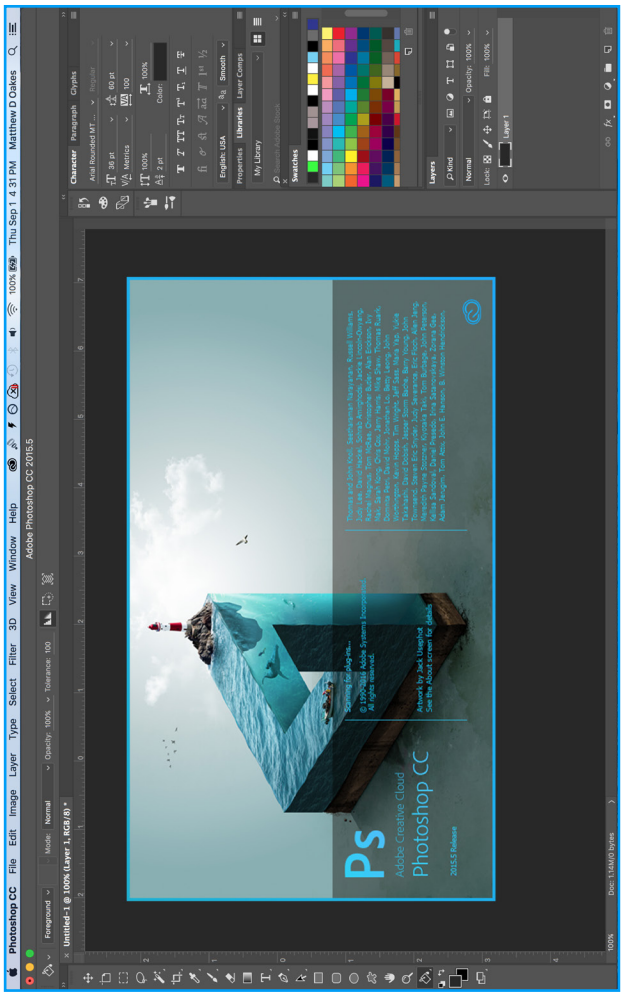
The ease of learning how to use Adobe's products will save money in training costs regardless of company size. Consequently, their will also be less time involved in training, and production of materials can begin sooner.

Interest in Project

As a proficient 2D designer, I have always looked for efficient ways of accomplishing as many tasks at a given time. I have many years of experience with the Adobe Creative Suite software packages all the way back from CS2, to my current monthly subscription to Adobe Creative Cloud. I have always had an interest in adding 3D design to my skillset. This project allowed for this opportunity by using those tools within Adobe Photoshop CC 2016.

Fig. 6 - Evolution of Photoshop
Source: adobe.com

2003 2016



CHAPTER II: LITERATURE REVIEW

Prototype \ˈprō-tə-ˌtīp\ **n.** Something that serves as a model or inspiration for those that come later. Derived from Greek and has the basic meaning "first in time" or "first formed."

~ Webster's Dictionary

What is Rapid Prototyping?

"Rapid prototyping" pertains to the output of physical objects or parts that are created using Computer Aided Design (CAD) software that became available in the second half of the 1980s. CAD files consist of data that describe three-dimensional space. Prior to rapid prototyping, it was necessary to carve prototypes out of a solid piece of material, which took some time. One form of rapid prototyping is *3D Printing*., This is an additive manufacturing process that builds objects one layer at a time from materials such as resins, photopolymers, and metal.

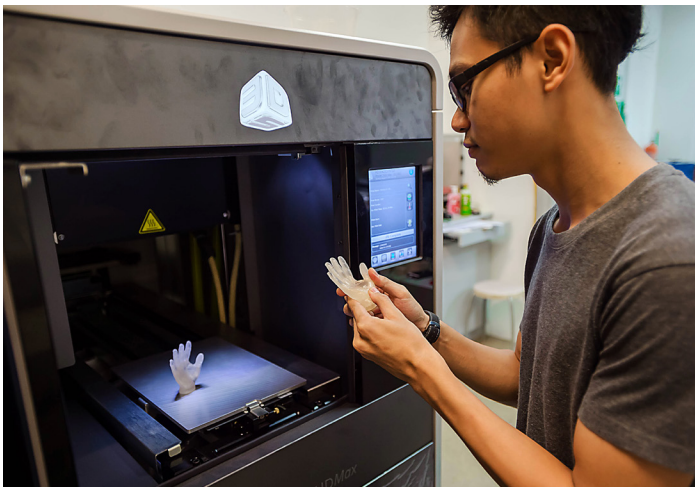


Fig. 7 - Prototyping at Nanyang Academy of Fine Arts
Source: http://www.nafa.edu.sg

A Brief History

The first ideas about 3D Printing came about in the late 1970s. In these early days, 3D printing was called Rapid Prototyping. It was called this because the processes were fast in comparison with the previous methods of machining parts, which was more costly.

Fig. 8 - IBM CAD Computer System (1983)
Source: vintageadbrowser.com

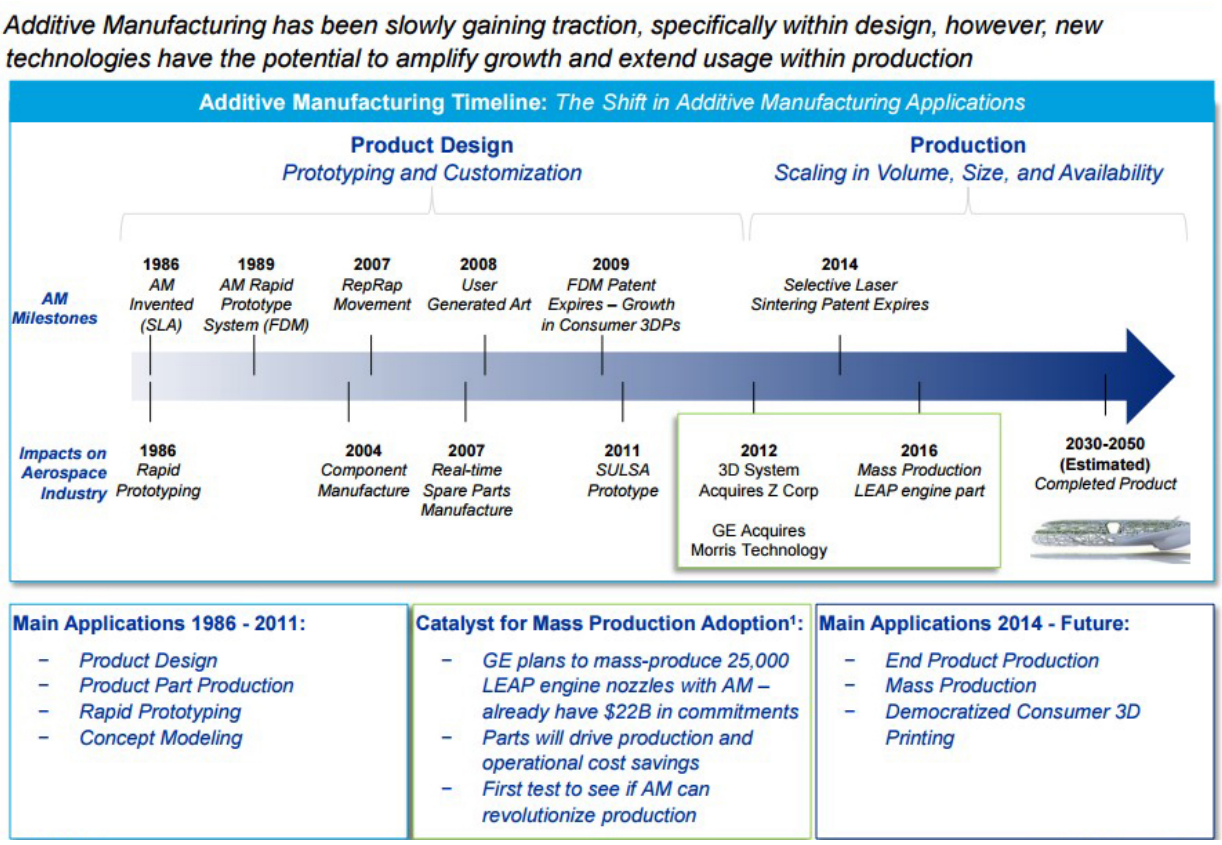


Fig. 9 - Additive Manufacturing Adoption Timeline
Source: www.forbes.com

The authoritative 3D design website, 3dprintingindustry.com, recounts that the first rapid prototyping patent was written in mid-1980 by Japanese manufacturer, Dr. Hideo Kodama. Unfortunately, the full specifications of his patent were not filed within the one year deadline for the application process. The patent for "3D Printing" was later filed by Chuck Hull in 1986. Hull's patent described the stereolithography (SLA) process that is used to this day.

Hull went on to create 3D Systems Corporation, which is one of the foremost companies that enjoy success in the 3D Printing industry to this day.

In 1987, Carl Deckard filed a patent for another 3D Printing process called selective laser sintering (SLS). The SLS process was later licensed to a company called DTM, Inc., which would end up getting bought out by Hull's 3D Systems. In 1989, another process called Fused Deposition Modeling (FDM) was created and in 1992, a patent was granted to Scott Crump, of Stratasys, Inc. In Germany, Hans Langer concentrated on a laser sintering (LS) process. The early 1990s saw a huge influx of companies that developed new techniques for producing 3D printed prototypes.

Currently, 3D Systems, EOS, and Stratasys are the only rapid prototyping 3D printers that remain competitive.

By the early 2000s, well-engineered parts production started taking place in the aerospace, auto, medical and jewelery industries. ("History of 3D Printing", 2016)

Significance of 3D Design and Output

The 3D Printing process is much faster than previous methods, as Professor Rafiq Noorani states, "It has made a positive impact on the manufacturing industry, cutting output time from weeks to just a few hours." (2006) According to Grimm, "Rapid prototyping is amazing, powerful, and revolutionary. Virtually every industry that designs and manufactures mechanical components has used rapid prototyping." (2004) Furthermore, rapid prototyping is a means to clarify a design for all people involved in the production of an end product. It allows for the communication of ideas and modifications between designers and engineers. According to Gelman (2015),

> …imagine the monumental importance of an innovation on the scale of Gutenberg's printing press for the replication and dissemination of material objects. **Such an invention would come to define a new epoch of human history.** What if I told you that such an invention exists? In that case, I would be talking about a machine that could replicate material objects with the same automation and efficiency of the printing press—in other words, a 3D Printer.

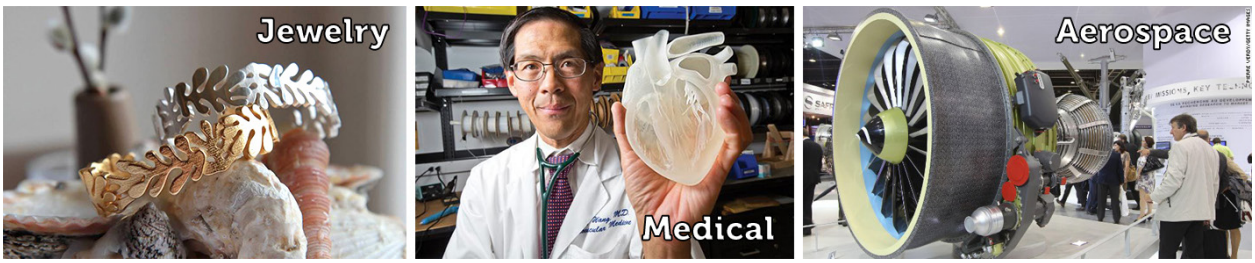


Fig. 10 - Current products made with 3D Printing
Sources: augmentedrealitytrends.com, bizjournals.com, cnn.com

There is much truth in Gelman's statement. There are countless benefits of 3D Printing in many aspects of business and society. Custom jewelry designs are created much easier. The automotive industry has more flexibility in making vehicles that stand out from the crowd. The aerospace industry can make engines much lighter, saving on the cost for rocket fuel to launch their crafts.

Perhaps one of the most important benefits of 3D Printing, would be the advent of printed skin and organs that can improve, or even save, people's lives.

Front-End Design Workflow

Fig. 11 - Human Design
Source: neomek.com

CAD technology has its roots in traditional drafting. As the desktop computer industry grew in the 1980s, it was natural that drafting would move from using a drawing board to the use of software applications. As software became more sophisticated, engineers and designers have become able to create more accurate and flexible 3D objects. These 3D drawings expand on orthographic (2D) layouts, allowing designers to visualize their work in relational space in comparison with other components of a project.

In today's world of 3D modeling there are a lot more capabilities. One such capability is to scan 3D objects to enhance the creation of new products. Mechanical Engineer, Jim Clark, (2013) shares his ideas:

> Three-dimensional scanning technology has become the mainstream tool for reverse engineering and complex part inspection. 3D scanning is also a powerful tool for new product design. It provides new capabilities to artists, designers, and engineers and allows companies to produce improved products while saving time and money.
>
> **Design with 3D Scan Data**: 3D scanning closes the gap between the physical object and the design software, enhancing typical product design. Without scanning, problems can arise such as the inability to create tight-fitting parts that need to attach to existing products. Scanning also improves the ability to create legacy parts that might be needed.
>
> **Aftermarket Product Design**: 3D scanning allows designers to create aftermarket products based on the shape of a mating part. An example of this would be making cases for products such as cellphones or laptop computers.
>
> **Ergonomic Product Design**: The ability to 3D scan human anatomy, instead of starting from scratch, allows for designing products that can then be superimposed on various human models. This helps the products become a perfect fit, especially in the case of items that are customized for each individual user.

Reverse Engineering: When an object is 3D scanned, a point cloud of X, Y, and Z coordinates is created. These points can be converted into a 3D model, which can then be recreated into a physical object, or modified to have any necessary changes.

Aside from Clark's particular niche of 3D design, there is a potentially complicated set of tasks that take place in order to manufacture products. There is also the challenge of deciding which 3D design software one wants to use, as there are quite a few applications on the market. The website *matterhackers.com* attempts to clarify the process of choosing your 3D modeling software, but it still looks to be cumbersome. In addition to the daunting selection process, the prices for the software, and any necessary plug-ins that assist the computer's communication with output devices, can be formidable. There are many other 3D design applications that are out there, including freeware, but the use of such products is not advised. An alternative to expensive and difficult-to-learn 3D software would be to use Adobe Creative Cloud applications for all steps in designing and outputting end products.

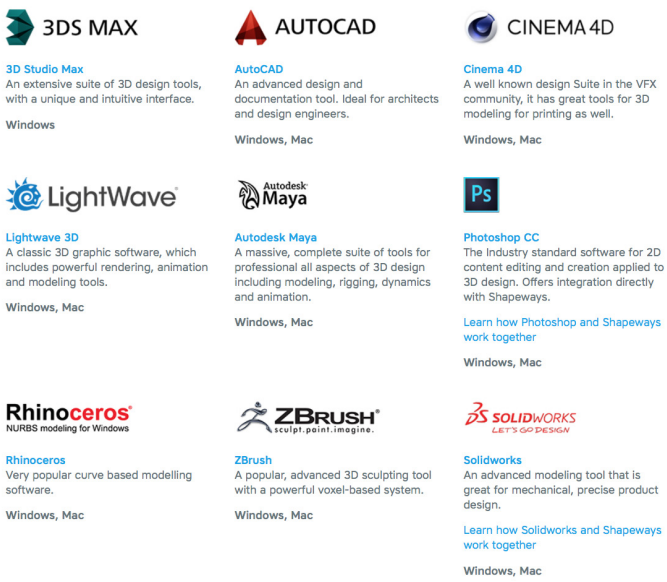


FIG. 12 - EXAMPLES OF COMPETITIVE 3D SOFTWARE
SOURCE: SHAPEWAYS.COM

ADOBE CREATIVE CLOUD

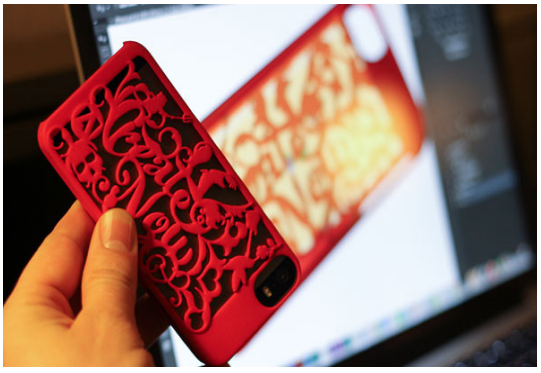


FIG. 13 - CUSTOM CELL PHONE CASE
SOURCE: HOWDESIGN.COM

Adobe has proven itself as one of the best creators of design software. In recent years, Adobe has added 3D tools to Photoshop, expanding this already complex application into even bigger creative realms. It is through the streamlined use of Adobe Photoshop's 3D tools, along with Illustrator and Photoshop's two-dimensional artwork capabilities, that the creation of

*Fig. 14 - **Shaver created by Stratasys and Adobe 3D Tools***
Source: tenlinks.com

an end product will be explored. No other manufacturer's software application will be used. Artwork, textures, and patterns created in Adobe Photoshop and Illustrator can be directly applied to 3D models.

In addition to creating a 3D printed specimen, I also consulted with 3D professionals to learn what methods they are using to develop their products. An analysis of timeline efficiency and cost comparison was also conducted to determine the benefits of switching to an exclusive Adobe workflow.

CHAPTER III: RESEARCH METHODS AND PROCEDURES

Methodology

The goal of this study was to determine whether or not 3D design workflows for manufacturing and production could be streamlined. This would consist of using only the Adobe Creative Cloud bundled software applications instead of using a mix of separate applications for 3D modeling and design of graphics to be later applied to finished products.

The objectives that were sought in this project are: (1) Can a 3D manufacturer save money by purchasing software licenses for Adobe Creative Cloud products, instead of purchasing them for multiple products? (2) Will using integrated software for 2D and 3D design save time, while giving the same results as using separate applications?

Data Collection

This methodology consisted of a small number of qualitative surveys and interviews with 3D design and manufacturing experts. Each interviewee will remain anonymous and are referred to as a "Participant." Questions were asked of each participant regarding length of experience in the 3D manufacturing industry, their roles, and the types of software they have used in the process.

Data Analysis

Through evaluating and comparing each expert's qualitative responses, a consensus is given on the feasibility of working solely with Adobe Creative Cloud as an option for streamlining the creation of 3D prototyped objects. A summary of each participant's responses is provided at the end of this paper.

Applied Exploration

Along with gathering information from experts working in the 3D industry, I underwent training on the use of Adobe Photoshop 3D Tools using the book *3D Photoshop for Creative Professionals* written by Stephen Burns. From studying this book, I was able to see the capabilities of using solely Adobe Creative Cloud applications for designing and prototyping. My observations are compared with the survey respondents.

CHAPTER IV: RESULTS

Qualitative Survey

In order to get a perspective on the use of various 3D software applications as well as exposure and awareness of Adobe's newer 3D Tools, a qualitative survey was conducted. Contact was made with a wide range of 3D designers and engineers via the professional networking website, LinkedIn.

Out of 25 people that were contacted, six questionnaires were completed. A breakdown of each participant's input is given below. To review a comprehensive matrix of Questions, Responses, and Demographic Data, see the Appendixes.

Participant 1

Participant #1 is a self-educated Director of IT and Design in Seattle, Washington. This person has 20 years of experience in the Design Industry, with the last two of these years spent working specifically with 3D design. The most significant changes they have seen in the industry is the rapid evolution of 3D printers and material options in recent years, as well as less there being skills necessary to operate newer equipment.

The software used by this person is Cubify Invent and Cubify Design to adjust many premade designs. They stated that Cubify Design is the more advanced design software. At this time, they have had no exposure to Adobe 3D Tools software.

Participant 2

Participant #2, a Structural and Graphic Designer from Dublin, Ireland, holds a National Degree in Product Design and Industrial Ceramics. They have eight years of experience in the Design Industry, with three of those years in 3D design making Standees, FSDUs, and prototyping.

For the last three years this person has worked with Esko Artios, and more recently moved to using KaseMake 11. The professional license for this new software cost the company £5,000.

This designer does not feel that their timeline can be shortened, as their work has an ongoing process, instead of being a quick prototype and then on to another phase.

They do not feel that Adobe Photoshop would be adequate for their vector-based work.

Participant 3

Participant #3 had some CAD training in school, but is otherwise self-taught via lynda.com and user forums on the Internet. They plan, manage, and implement projects using anything from AutoCAD and 3d StudioMax, to Bryce 3D and Vectorworks.

This Electromechanical Technician likes using Adobe Photoshop for creating and editing 3D object textures, but otherwise uses several other applications for rigging, lighting, and project plans. They are often looking for less expensive solutions to their needs, but still find that other programs are better matched for their projects than Photoshop. They also think it will be quite awhile before Photoshop will really be able to compete in the 3D arena.

Participant 4

Participant #4 hails from San Diego, California and has worked for 15 years in design. Ten years have been working with 3D prototyping. In the time they have been working with 3D, they have seen smoother processes, more options for materials, and the advent of printing in color.

They have worked with Pro-E, Catia, SolidWorks, SolidView and Adobe 3D and feel that they are pretty similar for creating and viewing 3D data. This participant is aware of the associated costs with most software subscriptions running from $50-$1,000, and purchasing from $500-$2,000+ for individual users. The costs for multiple users can be in tens of thousands of dollars. Solid and Adobe software are seen as lower cost versions.

The company this designer works for uses Adobe for populating 3D data that will be printed in colors. They also think that the simplicity of Adobe 3D tools will make it easier for designers and those familiar with Adobe software to give them competitiveness in the industry.

Participant 5

Participant #5 is a 3D design from Spain. They work with Solid Modeling or Sheet Metal and iLogic since 2014. As an Industrial Designer, they first became a CAD user in 1988 using AutoCAD V.9 MS-DOS, and from there used AutoCAD V.14 and 3D Studio. As of yet, they have had no exposure with Adobe 3D tools.

Participant 6

Participant #6 has developed concept vehicles for the power-sports industry since 2010. Prior to this they earned their Bachelors Degree in Industrial Design and has experience in rapid prototyping through model shop exposure at various jobs.

Since 2010, they have seen a big shift in companies starting to push the usage of all-inclusive software. In their experience, Alias is great for surface modeling, but not good for engineering related parts. Catia is great for engineering, but not for surface design. SolidWorks is good for all aspects, except surface modeling.

As far as finding a more cost-effective software solution, few companies would invest the time and money to retrain employees, let alone convert the whole company over to a suitable replacement, if found.

Finally, they feel that Adobe CC is a great suite to use as a designer, but that Adobe would need to acquire other companies that have 3D software that is already established, in order to truly compete in the 3D industry.

Applied Exploration

In order to get my own perspective on Adobe's 3D Tools software, I attempted to learn as much as possible during a ten-week timeline. To do this, I chose the tutorial book *3D Photoshop for Creative Professionals: Interactive Guide for Creating 3D Art* (Burns, 2015).

In his book, Burns gives simple and concise steps from how to set up the Photoshop interface specifically for 3D work, to how to switch between the different components of 3D design. These components are Environment, Camera, Lights, Mesh, and Textures, all of which make up a scene. An example project from this tutorial book can be seen in Appendix D.

In addition to the book itself, there is a companion App that is downloadable via iTunes and Google Play. By using the App, you can watch and follow along with the author as 3D projects are created. You are also able to see completed 3D objects to compare with your own work from following the tutorials.

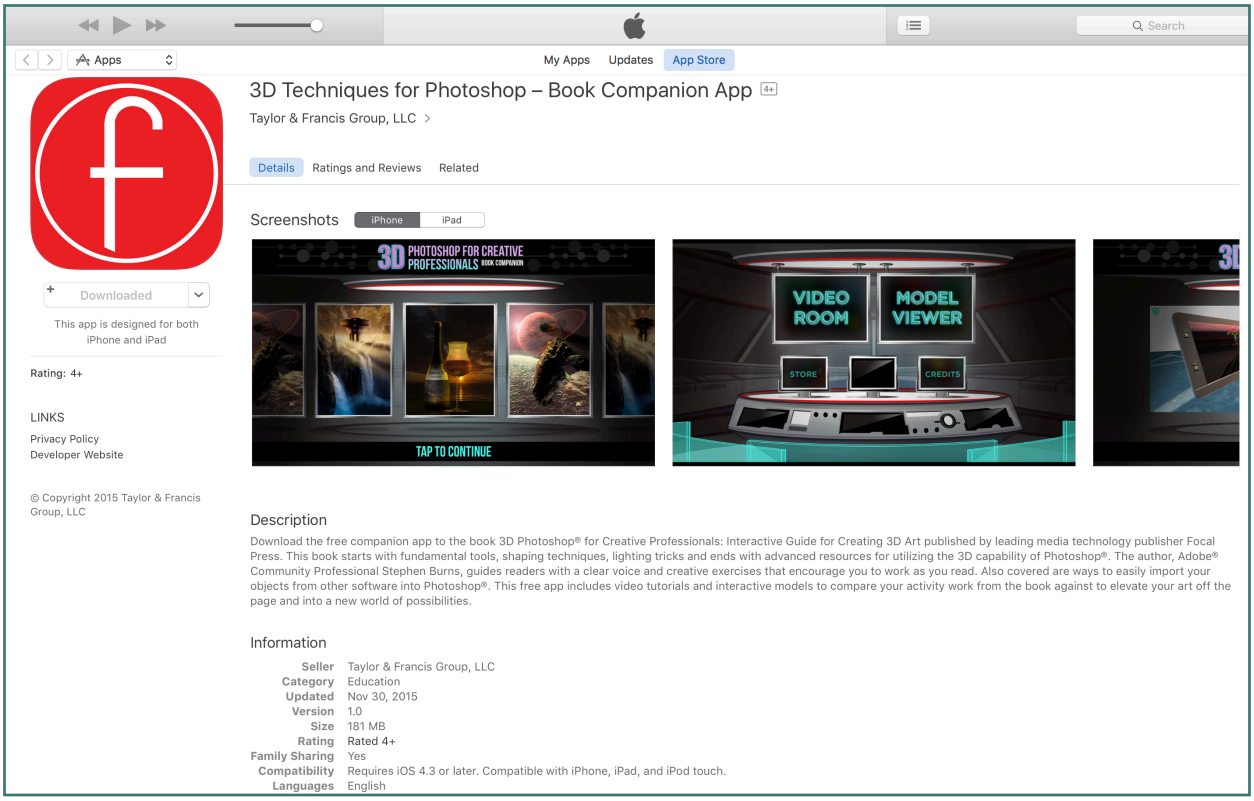


Fig. 15 - Tutorial Book Companion App
Source: apple itunes app store

CHAPTER V: CONCLUSIONS

Exposure to Adobe 3D Tools

While the amount of people that completed my qualitative survey was a small number, it does seem that a majority of them are not aware of Adobe offering 3D design solutions. There are virtually hundreds of 3D software packages available with a full array of modeling, texturing, and rendering capabilities built within. AutoCAD, SolidWorks, and similar offerings tend to remain the industry standards for industrial design and prototyping.

Out of the six participants, four of them had some knowledge or experience with Adobe 3D Tools. Participant #2 has looked into the offering, but had concerns about it being able to adequately render vector-based designs. Participant #3 likes using Adobe Photoshop 3D for creating and editing surface textures, but otherwise feels that it has a way to go before being on par with 3D industry standards of software. Participant #4 works with Adobe to populate 3D data and makes use of its software engine to print objects in color. Participant #6 feels that Adobe will need to acquire other 3D software companies and then integrate the stronger tools into the Adobe CC framework.

Applied Research

After exploring Adobe 3D Tools with the use of the book *3D Photoshop for Creative Professionals*, I learned that Adobe has some unique and somewhat powerful new tools as part of its repertoire, but found out that the tools do have a ways to go before being a truly viable choice for professionals in manufacturing and prototyping. I found that Adobe allows you to download and import many 3D objects that have already been created and lets you fine-tune them to be integrated into other 2D design projects.

During my ten-week project timeline, I enjoyed going through a couple of lessons in Burn's tutorial book and watched his companion videos. By doing this, I learned many of the basics that comprise 3D design, which was a good foundation. If I choose to continue my journey into 3D development on a professional scale, I would likely need to enroll in a series of courses, as well as delve into the many tutorials that are available at learning sites like lynda.com or shapeways.com.

Summation

I would have had better results had I been able to contact more 3D design professionals on LinkedIn, and perhaps through other channels. I discoveed that the array of people using 3D software packages are many, and varied. I initially found myself contacting some of the wrong type of professionals. Once I was able to redirect my search for the right participants, it got too close to my end-date to get enough data to verify Adobe's ability to compete within this specialized industry. In essence, this book is a good introduction to 3D design, but is by no means an extensive course into highly-detailed engineering and prototyping. It is more for a hobbyist who wants to see what the 3D world of design is about. My ultimate opinion would go along with the professional survey participants' insight that Adobe makes great products, but it will be some time before they are truly able to compete in the professional 3D software arena, where one can design, prototype, and output finished products that will become available for manufacturing and consumer markets.

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APPENDIX A

Survey Questionnaire

1. What is your Job Title and Description?
2. How many years have you worked within the Design Industry?
3. How many years have you worked in specifically in 3D Design and Prototyping?
4. What kind of education and/or training do you have in 3D Design and Prototyping?
5. What time-span(s) have you worked with 3D software?
6. What are the most significant changes you have seen in the field?
7. List the different 3D software applications you have worked with and explain the differences:
8. Are you familiar with the costs involved with acquiring 3D Design software? If yes, explain.
9. Do you believe you could find a more cost-effective solution for 3D Design? If yes, explain.
10. What kind of items do you design most often?
11. What is the average amount of time you spend working on them?
12. Do you think that this time-frame could be shortened? If yes, explain:
13. Are you familiar with Adobe Photoshop's 3D Tools? If yes, what have you done with them?
14. Do you believe Adobe's 3D Tools and integrated applications are strong enough for 3D designers to build their products in a competitive manner?

    Please explain either way you answered.
15. Where do you see 3D Design going in the next 5 years?

APPENDIX B

Survey Demographics

	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6
Job Title	Director IT / Design	Structural / Graphic Designer	Electro-Mechanical Technician	Project Specialist	3D Designer	Industrial Designer
Job Description	N/A	I work with a number of high profile Irish and UK customers across a mix of different formats and medias. This could be store window displays to Point-of-Sale stands.	Plan, manage, and implement projects (product design/ process engineering/ architectural / space planning)	Review data, oversee prototyping & production projects, identify any concerns & determine solutions.	Design with SOLID MODELING or SHEET METAL and iLOGIC	Work as a designer to develop concept vehicles for the power-sports industry.
Location	Seattle, WA	Dublin, Ireland	San Luis Obispo, CA	San Diego, CA	Palma, Spain	Thief River Falls, MN
Years in Design Industry	20	8	20	15	24	3
Years in 3D Design	2	3	10	12	2	3

APPENDIX C

Survey Responses

	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6
Education & Training	Self educated	National Degree in Product Design, Industrial Ceramics.	Some CAD training in school, mostly self taught (internet /Lynda.com/user forums)	Engineering, software, computer, processes, materials, prototyping, production, manufacturing.	I have been training for 3D with Autodesk Inventor software by TEDCF Academy between January 2012-October 2013	Bachelors degree in Industrial Design and experience in rapid prototyping through model shop exposure at various jobs and locations.
3D Design Time-Span	2013-2014	Last three years started working with Esko Artios and more recently moved (the last three weeks) KaseMake 11.	Autocad/3d studiomax/bryce 3d/Photoshop in the 90's as a theatrical set designer in my early years. A gap 2002 2010 when not designing professionally. I owned my own Special effects company where we designed characters/attractions/show control (lighting, sound, video, motion control, automation), and VFX(video effects) for the entertainment industry. I am mostly using Vectorworks/Unreal Engine 4/Blender/Unity/Photoshop/ Sketchup/ArtiosCAD.	10 years; 2005-2015.	I became a CAD user in 1988 on Autocad V.9 MS-DOS from there I used AUTOCAD-V.14 + 3D STUDIO.	2010 - Present
Significant Changes Seen in 3D Industry	Rapid evolution of 3D printers and material options in recent years. Less skill is needed to operate newer equipment.	I am still very new to CAD. I haven't noticed much change because my software is very current and up-to-date.	Moves to more inclusive environments (all in out tools) have made life much easier. The ease of use and ubiquitous Internet have made digital assets much more available and on demand.	Development of new technologies, evolutions in processes, expanding options for production-like materials, 3D printing in color.	The power of working on assemblies files.	There is a big shift in companies starting to push and encourage the usage of all inclusive software.
3D Software Experience	Cubify Invent. Cubify Design. Cubify Design is more advanced design software.	Esko Artios and more recently KaseMake 11	AutoCad/3d studiomax: Speed of development/controlled community left something to be desired. Bryce 3d: My tool for characters/animation/live-maps. Vectorworks: My default 3d design tool today. Powerful lighting engine/database integration/building docs/project plans/rigging diagrams/lighting plots, etc.) Unreal Engine 4/Blender/Unity: fantastic game engine. Creating video output of renders, VFX, or interactive environments/assets. Photoshop: texture editing and creation. Sketchup: quick mock-ups/simple prop creation. artiosCAD: Package design (ESKO proprietary software forKongsberg tables).	Pro-E, Catia, SolidWorks, SolidView, Adobe 3D. Though all are generally similar & are used for creating, viewing, rotating, measuring, & altering 3D data, Pro-E was first & Solid software was designed to be more user friendly.	I only work with Autodesk Inventor and in the past 3D studio	Alias - great for surface modeling, complex program but not good for engineering related parts Catia - great for engineering but terrible for surface design. Horrible UI Solidworks - Good all around program, weak on surface modeling but has a plethora of other tools for engineered and tested parts.
Familiarity with 3D software costs	Have researched pricing for design software like Solidworks.	My company just spent £5000 for a professional license for KaseMake 11 for myself.	N/A	We have a division that sells SolidView software. Formerly Solid Concepts, our company was the designer & manufacturer of that software. I have also been in the purchasing department & am aware of the high associated costs of most software. There are some free trial downloads available, but overall for individual users, subscribing can cost anywhere from $50-$1000 & purchasing from $500-$2000+. For companies with multiple users, the cost is much greater; high main purchase cost usually in the tens of thousands, plus a charge per seat ("user") after a certain qty.	N/A	Program fees can be immense, but the big cost driver is the long term maintenance charges that come up yearly and vary greatly depending on the number of licenses you purchase. Solidworks - Good all around program, weak on surface modeling but has a plethora of other tools for engineered and tested parts.
Thoughts on cost-effective solutions for 3D Design	N/A	I would find it hard to answer that question, but i would imagine it could be improved.	I am always looking. The costs are many. It has gotten better with free tiers and SAAS models for most software suites. The cost of rendering is still high, however with services like AWS EC2 GPU farms and Google's Zync, it is getting better. The ability to scale your tools on demand as work fluctuates is a huge help in an industry that fluctuates as much as production work.	Solid & Adobe softwares are lower cost solutions, especially for independent users.	N/A	I'm sure there are alternatives, but as it stands, very few companies can afford to pay their employees to learn and become proficient at new CAD software just to see if it will be better. Even harder would be the costs and challenges with converting a whole company over if a suitable replacement is found.
Items worked on most often	Adjusting pre-made designs.	Standees, FSDUs, Prototyping	Now, theatrical sets / characters, space planning models.	Protoypes for 3D printing tests, samples, products.	Industrial Design	Off-road vehicles
Average time working per session	30 min - 1hour per item	Full-Time, 5 days/week	4-80 hours/week (huge delta I know)	40 hrs per mo.	N/A	1-3 years, full-time.
Thoughts on work session efficiency	More experience & training would shorten time-frame.	Does not feel time can be shortened. An ongoing process.	Streamlining work-flows and spending more regular time in one tool would speed up my production. Due to the diversity of work, I am always learning a new tool. I almost never churn out repetitive tasks.	I do not do it very often so the amount spent is pretty low.	N/A	The plastic design process could potentially be sped up, but the immense amount of engineering and testing involved could not be reduced without greatly affecting the quality of the final product. in addition, the challenges with sourcing and working with so many suppliers on such a complex project means a lot of time is necessary just to go from a production ready product to an actual finished vehicle coming off the assembly line.
Familiarity with Adobe 3d Tools	N/A	I am would have found them very poor and hard to manage because its pixel-based, it easier to use illustrator be its vector based.*	I have created some basic 3D items and create textures in Photoshop. I have 3D printed name plates and some packaging parts using only Photoshop. The tools are EXTREMELY limited and counterintuitive. I am often vexed by Adobe's lack of 3D solutions. Painting on 3D items (i.e. blender) would be "simple" for Photoshop and just being able to use the paint tools to create textures smoothly would increase production significantly.	My company uses those tools to help populate 3D data that is to be 3D printed with colors.	N/A	N/A
Thoughts on Adobe competing in 3D Industry	N/A	I would work with Illustrator, Photoshop and Indesign on the Mac Pro daily and Kasemake on the PC, it would be great to have them all on the Mac Pro! (I hate PC's!)	ONLY for very limited applications. If you are only in need of the limited and imprecise tool set offered, you can use it without hopping between softwares. However, that has never been the case for most people I know.	I think that the simplicity of the program will make it easier for designers & the familiarity most users already have with Adobe will allow competitiveness in the software industry.	N/A	While Adobe CC is a great skillset to use as a designer, I have a hard time believing they could come out of the gate as a competitive 3D modeling asset without first acquiring other companies or programs with a history in the CAD world. It has taken many of the key companies the better part of the last two decades to streamline and improve their programs, which is something that cannot be streamlined overnight.
Where do you see 3D Design in 5 years?	N/A	With onset of VR, there might be a natural transition between the two.	Increased use of VR & AR interfaces. This will be another massive paradigm shift that I imagine will likely leave Photoshop behind for a few generations.	Evolving to provide more shortcut keys to enable quicker modeling & perhaps a straight to machine programming output.	I wish I knew! I guess is all about powerful machines and cloud computing.	I think as the industry evolves there will be a continued push to consolidate corporate offerings into single streamlined programs rather than 3-4 different programs to accomplish an "art to part" scenario.

APPENDIX D

3D Tutorial Example