

BAMBOO AS A NEW FIBER SOURCE IN THE US PAPER INDUSTRY:  
A FEASIBILITY ANALYSIS FOR BOOSHOOT GARDENS, LLC

BY  
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A THESIS

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FOR

BOOSHOOT GARDENS, LLC.

Approved: \_\_\_\_\_

Senior Instructor Anne Forrestel

There is opportunity for Booshoot Gardens, LLC to become a supplier in the U.S paper industry, build revenue, and secure future growth. This study is a feasibility analysis seeking to answer two questions: Can bamboo be used as a replacement fiber source for paper products, and do market conditions offer potential for a new supplier to enter the industry? Research came from working with scientists in paper engineering, as well as industry research to uncover the potential for a new supplier in the U.S paper industry. Booshoot staff agrees that in order to succeed in the paper industry the company must supply full grown, chipped bamboo to manufacturers in the sanitary paper industry, a small niche in the larger U.S paper industry. Based on this research Booshoot Gardens, LLC has already begun to find investors and expand the business into the U.S Paper Industry.

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Outside of the University of Oregon I would like to thank Phil Ferranto, General Manager at Booshoot Gardens who worked with me to meet the needs of Booshoot Gardens. I would also like to thank Professor Mark Lewis from the University of Washington who taught me how paper is made and what alternative fibers can be used to make paper. Last but not least, I would like to thank my family for giving me unconditional support and many editing hours. With all this support I was able to develop constructive recommendations for Booshoot Gardens which the company has already begun to implement. Thank you to everyone who aided in my growth as a student and as a professional.

## TABLE OF CONTENTS

|                                       |    |
|---------------------------------------|----|
| Critical Introduction .....           | 2  |
| What is Management Consulting?.....   | 7  |
| Consultant Client Relationship.....   | 9  |
| Change Models .....                   | 12 |
| Bigger Isn't Always Better .....      | 15 |
| Game Change Strategies.....           | 18 |
| The Research Process .....            | 20 |
| <br>                                  |    |
| Feasibility Study .....               | 25 |
| Executive Summary.....                | 26 |
| Company Overview.....                 | 29 |
| SWOT.....                             | 30 |
| Basic Paper Making Process.....       | 33 |
| History of the Paper Industry.....    | 34 |
| Industrial Pulping Process .....      | 37 |
| Industrial Paper Making Process ..... | 40 |
| U.S Paper Industry .....              | 43 |
| Bamboo in Paper Production.....       | 48 |
| Industry Analysis .....               | 52 |
| Recommendations .....                 | 65 |
| Ideal Partners in the Industry .....  | 67 |
| Next Steps .....                      | 70 |
| Conclusion.....                       | 71 |
| Appendix A.....                       | 72 |
| Bibliography .....                    | 78 |

### **Critical Introduction: The Theory of Consulting Work**

As a student in the Lundquist College of Business, I filled my course load with consulting and entrepreneurship classes. I am fascinated by research and decision making processes that can determine a company's success or failure. It was these interests which directed me to analyze the successful new venture Booshoot Gardens, develop a feasibility study for bamboo as a raw material in the U.S paper industry, and finally produce my Clark Honors College thesis.

This thesis has multiple components. The first is a critical introduction which covers the theory of consulting work that shaped my interactions with Booshoot as I worked as a consultant. The second half is the feasibility study which I presented to Booshoot Gardens on September 28<sup>th</sup>, 2010. This study included research on paper making, the history of the paper industry, the modern paper making process, and where bamboo can succeed. This necessary background allowed me to understand where Booshoot and bamboo fiber fits into the paper industry supply chain. I then combined a number of industry analyses to make recommendations based on current market conditions.

My recommendations and next steps for Booshoot come from the building blocks I discussed above and months of research. I am privileged to have had the opportunity to pursue my understanding of how new ventures succeed. Most of all I am pleased to share what I learned about the untapped potential to farm bamboo for a more sustainable paper source in the United States.

### Booshoot Gardens, LLC.

For my Clark Honors College thesis I have had the privilege of working as a consultant for Booshoot Gardens, a horticulture company located in Mount Vernon, WA, 60 miles north of Seattle. Booshoot Gardens started as an entrepreneurial enterprise in 1998. Botanist Jackie Heinricher wanted to find a way to mass produce young bamboo plants. Before Booshoot's new technology there were only two ways to cultivate young bamboo plants: waiting for a bamboo plant to produce seeds which can take up to 7 years, and root splitting, which often creates an unstable plant. Jackie Heinricher teamed with Randy Burr, a lead scientist working on a plant multiplication system, to develop a new system called tissue culture processing.

On a trip to the Booshoot laboratory I learned that the tissue culture process takes a root from a strong bamboo plant and surrounds the root in what Booshoot calls a multiplying gel. This gel is made up of mostly carbohydrates and other nutrients for the young plant. Once the plant reaches a certain size a lab technician moves the plant to a new gel that supports root growth. After these two stages are complete the plant is placed in the ground and grown in a greenhouse. This process allows Booshoot to produce over a million bamboo plants a year. Now with up to 50 employees during harvest season, Booshoot is a leader in bamboo propagation. Heinricher has been pleased with the growth of her company since Booshoot started in a small barn, but now Booshoot is looking for a way to share the benefits of bamboo with consumers around the world.

I started working with Booshoot as a student completing my capstone project for the Lundquist College of Business. I worked with 4 other students to develop a feasibility study which tested whether there was an opportunity for Booshoot in the textile industry. Although our initial findings recommended that Booshoot not attempt to enter the textile industry, I was still interested in working with Booshoot to help the company grow. The company's next direction was researching the use of bamboo in the paper industry.

Many companies in Asia have made advances in using bamboo in products such as textiles, flooring, cosmetics, paper, and food. However, many of these companies process bamboo in a way that takes away much of the sustainable qualities. Booshoot would prefer to work with companies who use a sustainable processing method called a closed-loop system. The closed-loop system uses fewer harmful chemicals that do not strip the fiber of its natural pliability. Other methods essentially turn the fiber into plastic or rayon which contaminates large quantities of water and uses an immense amount of energy.

The paper industry is global but a lot can be learned from the U.S paper industry and this is the scope of my thesis. Three questions drive my passion for this project: What does it take to make paper out of bamboo? Why hasn't the United States used bamboo on a large scale for paper production? Does Booshoot Gardens have a role in answering these questions? I found that paper can absolutely be made from bamboo fiber and that paper manufacturing companies will encounter low retrofitting costs to convert manufacturing lines from wood to bamboo. The main barriers Booshoot faces

are where to place itself in the supply chain and what cost-cutting measures are required to compete on price with the most common raw material, wood chips. The following thesis is a result of detailed research which allowed me to draw the final recommendations and next steps for Booshoot Gardens.



### The Feasibility Analysis

I have worked with Booshoot Gardens as a consultant for the last 6 months. My charge was to develop a feasibility analysis which focused on Booshoot's ability to enter the paper industry and identify what point of entry would be most appropriate. In the academic field of business a feasibility analysis is developed to help a client make a game-changing decision. My feasibility analysis follows the general criteria of an analysis including: basic research which builds credibility in the study, a report on the industry conditions including barriers and projected market growth, and lastly recommendations based on research and the company's strengths and weaknesses.

After months of research I recommend that Booshoot Gardens enter the textile industry as a supplier of raw material to pulp and paper manufacturers. Booshoot specializes in mass production of young bamboo plants or starts, but I recommend that the company expand and grow the bamboo to maturity, then chip the shoots to be used in paper production. An expansion of Booshoot's business scope will bring in the necessary revenue to make this change worth the risk.

In order to prepare to write this feasibility analysis, I began with extensive research on the theory behind consulting. My sources include management theory books, articles from the Harvard Business Review, and advice from veteran consultants. This introduction will detail the role of a consultant, the theory of a "change model" which consultants use, and how I used consulting theory in my own process.

### What is Management Consulting?

Each year billions of dollars are spent on management consultants and according to author Arthur Turner, "Much of this money pays for impractical data and poorly implemented recommendations. To reduce this waste, clients need a better understanding of what consulting assignments can accomplish. They need to ask more from such advisers, who in turn must learn to satisfy expanded expectations."<sup>1</sup>

As a student at the University of Oregon I worked as a consultant for Booshoot Gardens, a company wishing to expand their business and enter the paper industry. It was my job to first assess the needs of Booshoot Gardens and define a framework for my task ahead. I utilized Turner's 8 fundamental objectives for a consultant arranged hierarchically:

1. Providing information to a client.
2. Solving a client's problem.
3. Making a diagnosis, which may necessitate redefinition of the problem.
4. Making recommendations based on the diagnosis.
5. Assisting with implementation of recommended solutions.
6. Building a consensus and commitment around corrective action.
7. Facilitating client learning- that is, teaching clients how to resolve similar problems in the future.
8. Permanently improving organizational effectiveness.<sup>2</sup>

I used these objectives to frame my study for Booshoot. The goal of my project was to decide whether there is a place for Booshoot Gardens in the paper industry and what that place might be. Based on my level of education and experience I can best

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<sup>1</sup> Turner, Arthur. "Consulting is More Than Giving Advice." *Harvard Business Review* September-October 1982. No. 82510, 1.

<sup>2</sup> Turner, 2.

perform the first 4 steps, although, I worked to perform the more detailed phases.

Besides developing the right questions, researching, and making recommendations, I

have been diligent about bringing the client along throughout the whole process.

Building consensus and commitment to my recommendations throughout the research phase has also helped to build my credibility.

Arthur Turner goes on to write,

The idea that consulting success depends solely on analytic expertise and on an ability to present convincing reports is losing ground, partly because there are now more people within organizations with the required analytic techniques than in the boom years of 'strategy consulting.' Increasingly, the best management consultants define their objectives as not just recommending solutions but also helping institutionalize more effective management processes.<sup>3</sup>

It has been my goal to research the details about bamboo and how paper is made, but my recommendations also include next steps for management and questions for management to consider before committing to entering a new industry. I have made sure to give the research needed, but also what can be expected for the associated risk and costs.

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<sup>3</sup>Turner, 4.

### The Consultant/Client Relationship

Another author I consulted to define my role as a consultant was David Nadler. Nadler wrote an article, "Confessions of a Trusted Counselor," in this article he takes a more hands on approach with his clients. Nadler focuses on the upper tiers of Turner's pyramid. He first details the role between clients and consultant by defining the average CEO, "No one else in the organization is so starved for unbiased information. While CEOs understand in principle that everyone who seeks their attention has an agenda, they don't always know a bias when they see one." This was a challenging balance when working with Booshoot because this company has developed a unique tissue culture process that allows Booshoot to mass produce young bamboo plants. This is a very specialized process, but this process alone will not bring in the kind of revenue Booshoot is looking for. I developed recommendations for Booshoot to see that it is imperative to take on more than one phase of the supply chain. This change will bring in the needed desired revenue level, but I had to tread lightly so as not to unintentionally insult the client's unique service.

Nadler also builds a strong client/consultant relationship through frequent strategy discussions. Nadler says to always turn the question around. If a CEO asks you what you think about an employee it is ok to say, "what do you think about that employee and why are you asking me about his performance when you have a lot of data about him from other sources?" This allows the CEO to see that s/he is fully confident in their evaluation and it is the consultants' jobs to discover what more information the client needs to make a sound decision. I took this advice and had

frequent meetings with Phil Ferranto, my client contact at Booshoot. Phil was an MBA student at U of O years ago and remains the contact for Booshoot. I would often pose open-ended questions and turn questions around to help Phil develop the questions he needed to make the right decision.

When this project first started, Phil Ferranto thought he needed more information about what farmers in the southeast would grow and the price structure of wood chips. After initial research I found that there is not enough revenue in selling young bamboo plants to farmers. I recommend that Booshoot grow bamboo to maturity and chip it for sale. I wanted to educate Phil throughout the research process. I started with questions about what the company was capable of and where he thought revenue was in the supply chain. The clients I have worked with are always very aware of market conditions and allowing Phil to work through the change all along the way built confidence and credibility in the recommendations.

### When Consultants and Clients Clash

Before I began working with Booshoot I made sure to prepare myself for disagreements between client and consultant. The article, "When Consultants and Clients Clash"<sup>4</sup> by Idalene Kesner was my best resource. I learned to avoid many critical mistakes by observing the following rules: take the client seriously, learn the client's bias, bring the client along through the process, and discuss disagreements right away- do not let them sit.<sup>5</sup> These are standards in consultant work and emphasized over and over by authors in the field.

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<sup>4</sup> Fowler, Sally and Idalene F. Kesner. "When Consultants and Clients Clash." *Harvard Business Review* November-December 1997, 2.

<sup>5</sup> Fowler, 6.

### Change Models: The #1 Tool of a Consultant

The #1 tool of a consultant is to understand how a company changes. There are dozens of growth and change models that detail how a company receives recommendations from consultants and changes.

The most prominent change model is from Kurt Lewin. Manfred Kets de Vries writes about Lewin's Change Model in his management strategy book, "Family Business on the Couch: A Psychological Perspective." Manfred states, "Kurt Lewin's work on group dynamics led to the awareness that group work can be an effective tool for changing ideas and behavior... Lewin made several important observations on change that help us to think about challenges that arise during transitions."<sup>6</sup> The following are the critical Lewin strategies to understand in working with Booshoot Gardens:

- 1) The success of any organizational change depends on that organization's ability to manage the conflicting forces that both restrain and drive the process.<sup>7</sup>
  - It was important that I recognized that Booshoot wants to grow but the company itself is having trouble keeping the doors open on a day-to-day basis. I could not develop any recommendations with considerable added costs unless it was going to yield considerable profit.
- 2) An organizational system will resist change when the people in that system are not involved in developing plans and making decisions.<sup>8</sup>

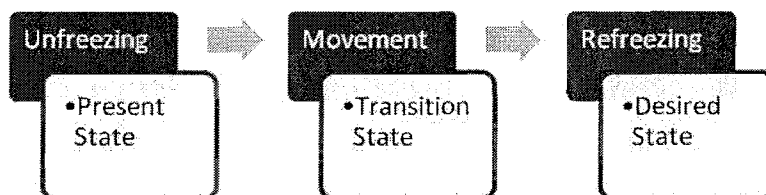
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<sup>6</sup> Kets de Vries, Manfred F.R. *Family Business on the Couch: A Psychological Perspective*. John Wiley & Sons, Ltd. 2007, 17.

<sup>7</sup> Kets de Vries, Manfred F.R, 190.

<sup>8</sup> Kets de Vries, Manfred F.R, 190.

- I worked with Phil Ferranto from Booshoot every step of the way to engage him on the ideas I was researching. By the time the presentation came Phil already knew all the steps that led to making my final recommendations.
- 3) Change is more likely to occur when management engages the entire organization in the process, because agreement on the need for change is even more important than the change itself.<sup>9</sup>
- This point was easy because all of Booshoot's leadership wants to expand the company and they know they need change in order to accomplish the change needed. My challenge was in reframing their expectations of what that change would look like.
- 4) For change to occur a group must first 'unfreeze' its current behaviors and then work through a process of communicating and learning, eventually identifying new behaviors before finally 'refreezing' (or making the new behavior a part of the group's norm).<sup>10</sup>



<sup>9</sup> Kets de Vries, Manfred F.R, 190.

<sup>10</sup> Kets de Vries, Manfred F.R, 191.



- I discussed Lewin's process with Phil. The research and this feasibility analysis will help to drive staff through the unfreezing process. I also recommended continued research to push the company through the movement stage.

Although Lewin's Change Model is the most widely used change model it is not the only source I consulted when thinking about the right kind of growth for Booshoot.

### **Bigger Isn't Always Better**

New consultants often focus on finding ways to expand a business, but growth for the sake of growth is never good. Researcher and author of "Bigger isn't Always Better," Robert Tomasko writes, "Growth is about progress, not bigness. The point of growing is to achieve full potential, not to maximize size. A business grows whenever it moves beyond the self-imposed limits that define and constrain it."<sup>11</sup> In order to expand, Booshoot Gardens will have to move beyond its biotech base. The paper industry is not craving biotech companies at this time. Instead the industry is craving a new raw material that has been developed and researched by a company with a biotech arm of its business. Booshoot will need to move beyond its current specialties in order to take a piece of a very lucrative industry.

Tomasko goes on to write, "Not only does growth require moving beyond current boundaries, which themselves may be moving as well as hardened targets, but the business must also stay at the new destination long enough to reap rewards for having the journey. And it has to do all this in a way that allows its newly found wealth to be shared with those who have contributed to its success."<sup>12</sup> Booshoot Gardens will have to work with investment banks and private investors who support new venture expansion in order to farm bamboo in the southeast. I recommend this because Booshoot will bring in more revenue if it sells chipped full grown bamboo. Bamboo takes three years to grow and in that time Booshoot will need investors to support the

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<sup>11</sup> Tomasko, Robert. *Bigger Isn't Always Better: The New Mindset for Real Business Growth*. American Management Association, New York. 2006, 48.

<sup>12</sup> Tomasko, 50.

business before a crop can be harvested. Booshoot will need to account for the necessary sharing of wealth and high interest rate when setting the price point for its bamboo chips. This is addressed in further detail in the feasibility analysis.

The right expectations are also important for growth. Author Tomasko writes,

The smooth upward-moving curve on PowerPoint slides that has come to symbolize growth is not so much wrong as it is incomplete. Accelerated upward movement is only a portion of the complete growth life cycle. A growth trajectory, expressed visually, really begins with a long, almost flat horizontal line, usually beginning several years ahead of the upswing.<sup>13</sup>

As a consultant, is it important that I detail the growth expectations in my action steps.

Although, it is feasible for Booshoot to enter the paper industry and find success, more research needs to be done to decide which point of entry the company will take.

Booshoot needs to also find the right bamboo and that will take more research. The company has narrowed their options to the paper industry and the southeastern region of the United States and I have recommended a narrowed business model.

Narrowing is part of the growth phase, but final decisions that yield success will take more time to develop. It is my job as a consultant to develop the vision of success, while keeping the client grounded in the work that still lies ahead. Tomasko's book also emphasizes keeping a clear sense of reality, "Reality, especially marketplace reality, is in constant flux. Customers and competitors come and go. Their needs and behaviors change... All this cacophony create a perceptual problem: How can we get on with things if much of what is going on around us refuses to settle down? The easiest way to

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<sup>13</sup> Tomasko, 50.

deal with constant change is to ignore it, at least for a little while. When this becomes difficult, our common fallback is to categorize it.”<sup>14</sup> As a consultant it is my job to be aware of the day to day changes that affect the company.

Booshoot is a wholesaler for nurseries and currently works in the horticulture industry. This industry has faced many challenges during the last recession and change can be hard for a company that struggles to keep its doors open. When making my recommendations I worked to make suggestions that would focus on yielding revenue and I recommended further research and added costs only when it was necessary and worth the risk.

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<sup>14</sup> Tomasko, 58.

### Game Changing Strategies

Understanding the Lewin's Change Model and researching different definitions of growth prepared me to research different business models that have adapted well to change. Author of "Game Changing Strategies," Constantinos Markides writes, "A business model is the sum of the answers that a company gives to these three interrelated questions: Who should I target as customers? What products or services should I be offering them and what should be my (differentiated) value proposition? How should I do this in an efficient way?"<sup>15</sup> From this book I began to understand as a consultant it is imperative that I understand the core questions to developing a good business model.

My next task was to assess growth and the innovative potential for Booshoot Gardens. Entering the paper industry could have meant Booshoot would sell young bamboo plants to farmers who would sell bamboo chips to paper manufacturers. This plan would have kept Booshoot as a horticulture company, but as I will detail later this would not have brought in enough revenue to be worth the risk. Booshoot needs to innovate if it is going to succeed.

Markides defined innovation similarly to other authors, but his definition resonated best with me. Markides writes:

To qualify as an innovation, the new business model must not only be new to the innovating company but also new to the world. For this to happen, the new business model must be offering something that nobody else is currently offering. This might seem an unusually high hurdle to

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<sup>15</sup> Markides, Constantinos. *Game-Changing Strategies: How to Create New Market Space in Established Industries by Break the Rules*. A Wiley Imprint. 2008, 6.

jump, but what it effectively means is that the innovation must not only steal market share from established competitors but should also enlarge the existing economic pie—either by attracting new customers into the market or by encouraging existing consumers to consume more. In this sense, the innovation creates value rather than simply being a value transfer from one firm to another.<sup>16</sup>

When I first started working with Booshoot I worked with a group of students to study the feasibility of Booshoot entering the textile industry. There were no options to innovate or succeed in that industry. But when I started researching Booshoot's potential place in the paper industry I quickly realized that Booshoot can innovate and create value. In the United States 80% of the raw material used in making paper is wood. Booshoot can create value by helping the industry move away from its reliance on the volatile timber industry. Booshoot can provide a more sustainable, cost equivalent product, which will yield high quality paper. This is innovation and it is important as a consultant that I developed recommendations which would help Booshoot innovate and not simply transfer value from one firm to another.

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<sup>16</sup> Markides, 7.

### The Research Process

I utilized as many authors and veteran consultants' expertise as I could find when working with Booshoot Gardens. My thesis advisor Anne Forrestel and my professor Beth Hjelm, whom I worked with on the textile project, have all previously done research and consultant work. I developed my recommendations for Booshoot based on the aforementioned theory, experience, and my education. My process in working with Booshoot can be broken down to the following 6 steps:

1) Learn about the company.

A feasibility study starts with an analysis of the current situation. I started with a SWOT analysis to assess the strengths and weaknesses of the company and the external opportunities and threats. Harvard Business Review author, Arthur Turner, states the first objective of a good consultant is to provide information to a client.<sup>17</sup> I had to start by understanding what the company knows and the experience of Booshoot Garden's leadership. Booshoot has a small but tenacious staff. I provided context and background research in my analysis because there is no development team at Booshoot, and each position has a myriad of daily tasks. To bring the whole team along my research started from the beginning which is, how does one make paper? By starting from the beginning I can make sure to appeal to every employee's needs.

2) Frame the questions that will best inform company decisions.

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<sup>17</sup> Turner, 1.

My next role was to work with Booshoot, specifically the General Manager Phil Ferranto, to frame the questions. Phil Ferranto believes that Booshoot can grow and compete in larger industries, so just like author Nadler said, as stated above, “my job—my only job—was to help him succeed.”<sup>18</sup> I started with background research and once I decided there were no glaring barriers to entering the paper industry I worked with Phil to identify how he envisioned Booshoot’s point of entry.

This was an ongoing process. I brought him along with each stage of my research and together we edited the questions all along the way. The project started with Phil wanting Booshoot to sell young bamboo plants to farmers in the paper industry. This would require expensive orchestration between farmers and paper manufacturers to commit to making paper from bamboo. The smallest amount of profit occurs at the early stages of the supply chain and this plan would have limited Booshoot’s revenue stream because it would not have owned the mature bamboo which is where the profit is.

Once Phil understood this conclusion we worked to identify what information Booshoot would be needed to grow bamboo to maturity to be chipped and sold. The question was redefined which shaped the research around the paper industry, commercial paper processing, and an industry analysis.

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<sup>18</sup> Nadler, 3.



3) Find resources and work with experts to inform recommendations.

For this portion I worked with my thesis advisor to find a specialist in paper science that could help me understand how bamboo functions in the paper processing. I concluded if bamboo could be used in standard paper manufacturing with little retrofitting, then Booshoot could succeed as a raw material supplier. I found Mark Lewis who is the Director of the Non-wood Fiber Center of the Paper Science Department at the University of Washington. Professor Lewis taught me how the pulp and paper manufacturing process works. In strategizing with Professor Lewis I decided that bamboo can work in paper manufacturing. This information opened up my questions to what the business model would look like.

4) Use IBISWorld to assess the market conditions of the small markets affecting Booshoot ability to enter the paper industry.

IBISWorld is an internationally renowned resource for industry analyses. I used this source to develop my understanding of the paper and pulp industry. The paper industry is an overarching term which covers many smaller industries. In order to best understand industry conditions facing Booshoot three industry reports are analyzed:

- 1) Paper Mills in the U.S
- 2) Wood Pulp Mills in the United States
- 3) Sanitary Paper Product Manufacturing in the U.S.

The projected growth for each of these industries helped me to understand the barriers facing Booshoot. I also ascertained information about the key success factors in each industry which helped me to shape my recommendations.

5) Finalize recommendations and search for critique.

I sought out critique first and foremost from my thesis advisor Anne Forrestel. Anne directed my project and helped me strategize my recommendations. As a young college student, with a moderate amount of life experience, I would not have felt comfortable handing over my recommendations to Booshoot without vetting my ideas first. Author David Nadler talks about finding a second opinion in his article "Confessions of a Trusted Counselor." I will always seek constructive criticism to push my work to the next level. Constructive criticism also helped me solidify my opinions and allowed me the chance to defend my recommendations over and over again.

I also sought out editors in my friends, family, and roommates. Anyone that would read a piece of my thesis and tell me what they thought I handed them pages. Today, I can explain paper manufacturing to anyone because I had the chance to talk about my work and discuss my findings as often as possible.

6) Present findings to Booshoot and defend recommendations.

On September 28<sup>th</sup>, 2010 I drove up to Mount Vernon, Washington to present my findings to Booshoot Gardens. I gave a verbal presentation to my client contact Phil

Ferranto. I then allowed for an hour of discussion and I gave the company a bound copy of my report, which is the second half of this thesis. Phil Ferranto gave high praise to my report saying it was what just what the company was hoping for and that my report was extremely thorough.

Booshoot Gardens has already started to find investors to propagate full grown bamboo and search for manufacturing partners in the paper industry. Phil Ferranto has shared my report with the rest of the Booshoot Gardens staff. Lastly, Booshoot gave me a young bamboo plant as a gift of thanks.

### **Critical Introduction in Review**

My ability to produce sound research for Booshoot was aided by authors in the Harvard Business Review and management strategy specialists who set the foundation for my thesis with their books. Experts and veteran consultants helped me define my questions and critique my recommendations. The best consultant comes prepared to redirect the client's initial theories and spend time guiding the client through the research every step of the way.

The next portion of my thesis for the Clark Honors College is the feasibility analysis I delivered to Booshoot Gardens. You will find the entire report and a complete bibliography. The report has been written in a different format to meet the requirements of a feasibility analysis for the Lundquist College of Business at the University of Oregon.

**Emma Kallaway**

**Bamboo as a new fiber source in the US Paper Industry:  
A feasibility analysis for Booshoot Gardens, LLC**

**Lundquist College of Business  
Robert D. Clark Honors College**

**September 28<sup>th</sup>, 2010**

## Executive Summary

There is opportunity for Booshoot Gardens in the paper industry. The potential for new revenue streams and capacity building is worth the risk and expense. The following feasibility study will aid Booshoot Gardens in its drive to grow the company's versatility and capacity. This study is focused on the United States because the U.S is a leader in the industry and provides an ideal framework to understand industry trends. The big question is, can Booshoot be a successful supplier to the paper industry? There are two distinct pieces to answering this question: the role of bamboo as a raw material and the role of Booshoot in the supply chain.

The success of Booshoot in the paper industry could not be decided until research was completed on the potential of bamboo as a source of paper fiber. Research shows bamboo fiber functions the same as wood fiber when manufacturers process paper pulp. There are opportunities for paper manufacturers to use bamboo and improve their bottom line. Bamboo paper can be differentiated from paper made from wood because using bamboo in the paper-making process will cut costs and bamboo is a more sustainable raw material than wood so a premium can be charged to environmentally conscious consumers.

Once I understood that bamboo paper can succeed in the industry, I needed to identify how Booshoot could enter the market. Booshoot needs to grow and secure a strong revenue stream to outweigh the expense and risk of attempting to enter a new industry. This means focusing on markets in the southeast portion of the United States. The paper industry in the United States is now located in the southeast and shipping raw material from anywhere else in the world only adds to manufacturing costs.

Booshoot should setup operations in the southeastern region of the U.S, but how they will do this is vital. Originally, Booshoot thought it could sell young bamboo plants to commercial farmers who would grow the bamboo to full size and chip the plant for sale. However, I found that this would place Booshoot at the lowest stage of the supply chain and provide the business with very little added revenue. Instead, Booshoot should grow bamboo to full size and chip the shoots. This would make Booshoot a supplier of fiber chips, a stage further along in the supply chain that will bring in more revenue.

The highly competitive paper industry is run by a few large corporations which operate multiple stages of the supply chain. In order to increase Booshoot's profitability it must participate in more than one stage of the supply chain. Seeking partnerships with leaders in the industry will increase the profitability for Booshoot in the paper industry because companies that control more than one stage can be flexible enough to adapt bamboo into their manufacturing process. Booshoot needs to control the raw material into the chipping stage of the supply chain in order to maximize profitability and make this endeavor worth the risk.

The following research will prove there is a place for Booshoot in the paper industry. To make a profit, Booshoot needs to partner with companies in the southeast who will buy chipped bamboo to make paper.

## **Introduction**

The following study will identify how Booshoot can succeed in the paper and pulp industry. Most importantly, current research shows that bamboo can be a substitute for wood chips and produce high quality paper with little to no added manufacturing costs. However, this study will not calculate revenue projections or identify the exact costs of producing paper out of bamboo. All costs are estimates based on current market research; a further study will have to be conducted to identify the projected revenue and costs associated with entering the paper industry.

Next it is vital to understand the supply chain and industry conditions. The paper and pulp industry is strongly affected by what the end user is willing to buy, called downstream demand. Therefore, understanding the consumer is very important to every stage in the supply chain. Bamboo paper will appeal to the end user because it can be cheaper to manufacture and it is considered more environmentally friendly. Booshoot needs to work with companies in the industry who understand the potential for bamboo to differentiate products and bring in new revenue from cost-conscious and environmentally-conscious consumers.

Finally, the risk and costs of entering a new industry leave Booshoot with no choice but to go after this objective with full force. Booshoot needs to work with major players in the paper manufacturing industry who also buy raw material to process their own pulp. If Booshoot can commit to supplying more than bamboo starts (small plants), it will have the potential to sell directly to manufacturers and bring in the needed revenue to make this initiative worth the cost. In order to understand the following research, it is important to start with a clear understanding of Booshoot Gardens, LLC as a company.

### Company Overview

Booshoot Gardens is a biotechnology company located in Mount Vernon, Washington approximately 60 miles north of Seattle. Booshoot has a specific niche in the biotech industry. Its breakthrough tissue-culture science, as Booshoot's website states, "enables rapid propagation of bamboo plants on an unprecedented scale."<sup>19</sup>

Winner of local and national awards, owner and founder Jackie Heinricher turned tissue-culture science into a growing entrepreneurial enterprise. Booshoot was launched in 1998 and in 2004, "Heinricher and Booshoot senior scientist Randy Burr, "cracked the code" on bamboo tissue culture, a process which roughly takes bamboo DNA and mixes it with natural byproducts to support the growth of young bamboo plants. This enabled Booshoot to supply wholesalers with over one million plants annually along with already established horticultural offerings."<sup>20</sup> Eight years of research and development have established Booshoot as a leader in bamboo tissue-culture research and the numerous uses for bamboo worldwide.<sup>21</sup>

Today, the company continues to challenge the high barriers to entry in very traditional industries such as paper, textiles, agriculture, etc. Incorporated into Booshoot's mission statement is a goal to educate company leaders around the world about the unique qualities bamboo fibers can provide in developed products and innovative ideas alike.

Booshoot Gardens works to keep the day-to-day business running by selling plants to nurseries and wholesalers. The other part of the business is driven by the vision of Booshoot to bring bamboo to consumers worldwide. Company leaders all have development tasks. Research is shared and the drive to enter into the paper industry is a decision that the staff came to together and has started to move on quickly.

Currently, the development staff at Booshoot Gardens is researching various uses for bamboo fiber in the paper industry. The following analysis of Booshoot's competitive position is centered on Booshoot's ability to sell its bamboo tissue-culture, also known as bamboo starts, to farmers as well as pulp and paper manufacturers.

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<sup>19</sup> "About Booshoot," last modified 2009, accessed August 18<sup>th</sup>, 2010.

<http://www.booshootgardens.com/Homepage.cfm>.

<sup>20</sup> "About Booshoot."

<sup>21</sup> "About Booshoot."



### SWOT: Strengths, Weaknesses, Opportunities, and Threats

Definition: The SWOT analysis is designed to examine both internal and external factors that can either advance or alter the company's overall competitive position. A SWOT helps to organize strategic approaches to capitalize on the company's strong points and better position its approach to manage its weaknesses. A SWOT analysis starts with the definition of the industry.

Industry: This SWOT analysis is used to analyze the factors that will assist Booshoot Gardens in entering the paper and pulp industry. Specifically, this analysis will focus on Booshoot's ability to sell bamboo to paper manufacturers in the Southeast region of the United States. Below is the SWOT.

#### Booshoot Gardens: Internal Factors

##### Strengths:

- Tenacious staff and company leadership seeking valuable partnerships
- Booshoot Garden's mission is to be an environmentally sustainable business. This is attractive to companies looking to adopt environmentally sustainable practices.
- Innovative technology enabling, "markets worldwide to meet the growing demand of bamboo for use in wood products, pulp for paper and textiles, soil stabilization, and reforestation combined with bamboo's untapped potential for carbon sequestration."<sup>22</sup>
- Located in the Pacific Northwest, a hub for biotechnology and environmental conservation resources
- Wide range of company experience in horticulture and agro-forestry

##### Weaknesses:

- Inexperienced in large scale marketing and advertising
- Limited development funds and staff time devoted to pursuing innovative uses of bamboo
- High R&D costs to entering the paper industry
- Lack of experience with the paper industry
- Lack of research on comparable fiber cost in the pulp industry
- In need of research to best position Booshoot in the paper and pulp industry

#### External Factors

##### Opportunities:

- Growing cultural norms push consumers to demand businesses with strong values placed on environmental conservation

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<sup>22</sup> "About Booshoot."

- The United States is number two in paper production with 16.4% of the global market<sup>23</sup>
- Competition is low for Booshoot: paper can be made from bamboo pulp fiber yet companies in the United States have not attempted to manufacture on a large scale<sup>24</sup>
- The weak U.S dollar has made exports cheaper, so U.S based businesses are seeing an increase in demand for their cheaper product<sup>25</sup>
- Booshoot's product itself is more sustainable than using virgin wood which allows for vast marketing possibilities especially directed at the environmentally conscious consumer
- Annual growth of the paper mill industry is expected to decrease by 1.6% annually<sup>26</sup>

#### Threats:

- Manufacturers are concerned that using bamboo fiber would mean retrofitting machinery and changing their chemical processing<sup>27</sup>
- Farmers are wary of growing new products and risking not being able to profit<sup>28</sup>
- There are many existing alternatives to pulp made from bamboo fibers
- There are unforeseen risks to entering an industry that has been using a single raw material for centuries.

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<sup>23</sup> Sonja Lekovic. "IBIS Industry Report Paper Mills in the US." *IBISWorld* no. 32212. 2010, <http://www.ibisworld.com.libproxy.uoregon.edu/industryus/default.aspx?indid=406>, 7.

<sup>24</sup> Maureen Smith, *The U.S Paper Industry and Sustainable Production: An Argument for Restructuring*. (London, 1997), 17.

<sup>25</sup> Lkovic, 9.

<sup>26</sup> Lkovic, 2.

<sup>27</sup> Phil Ferranto. Phone Interview. August 4, 2010.

<sup>28</sup> Phil Ferranto. Phone Interview. August 4, 2010.

## Implications

Booshoot has the necessary strengths to succeed in the paper industry if it follows four important steps. These steps will be addressed in further detail in future sections.

1. It is possible to make commercial quantities of paper out of bamboo, and Booshoot is a leader in large-scale bamboo propagation. Booshoot needs to develop relationships with companies who will purchase all of the bamboo Booshoot can produce. A guaranteed purchaser agreement will ensure that Booshoot makes the revenue it needs. A paper manufacturer will most likely experiment with one line of bamboo at first until bamboo proves to be a viable fiber source. A guaranteed purchaser agreement will also allow the manufacturer the flexibility to purchase bamboo other places if the company needs more fiber than Booshoot can provide.
2. Booshoot can make up for a lack of company resources and capacity by commissioning research on the ideal bamboo for paper pulp as well as information on any unforeseen manufacturing retrofitting that would be needed. This study should also include the climate conditions that affect agriculture in the southeastern region of the United States.
3. Booshoot needs to commission a study to set a profitable price for its bamboo that will also allow paper manufacturers to make a fair profit. Although wood chips are not perfectly comparable to bamboo chips that could be sold at a premium, the current market price for a ton of wood-chips in the U.S is between \$100-\$130 a ton.<sup>29,30</sup> Booshoot will need to research how many acres of which type of bamboo will yield a ton of chips and then decide whether it can grow bamboo to maturity and make a profit at fair market price. However, all information indicates that this endeavor is profitable because bamboo is cheaper to grow than trees in many ways.
4. Lastly, it will be vital for Booshoot to research its positioning and partnerships carefully before investing further resources into entering a very challenging industry.

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<sup>29</sup> Global Trade, Inc. "Price of Wood Chips." 2010. <http://www.alibaba.com/showroom/wood-chip-for-pulp.html>.

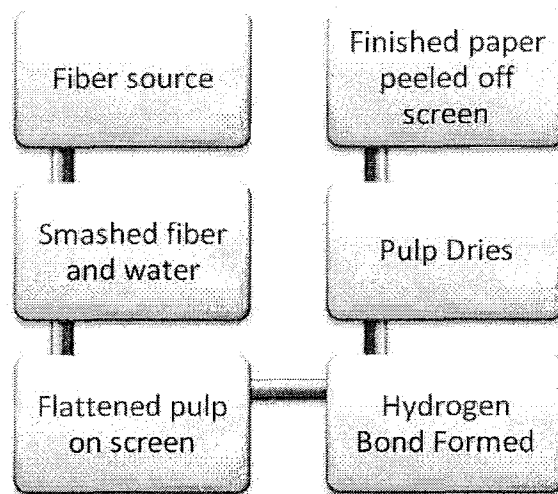
<sup>30</sup> Professor Mark Lewis, interview with author. University of Washington Paper and Pulp Non-Wood Fiber Lab. August 13<sup>th</sup> 2010.

### Basic Paper- Making Process

Now that Booshoot's strengths and weaknesses have been clearly defined, the following sections will explain the general paper-making process and historical development of the industry to provide context for the role of bamboo in today's commercial paper industry.

Paper can be made at home in a bathtub or on 100 foot rollers in a paper manufacturing facility in Tennessee.<sup>31</sup> Paper is made by first smashing up a fiber source like recycled paper, wood chips, and even alternative fibers like grass, small braches, and bamboo. The fiber is then mixed with water to continue to break down the fiber in a process called pulping. The smaller the individual fibers strands, the finer pulp, the finer the paper.

The pulp is then placed on a screen and the water is dried out. As the water drains out a hydrogen bond forms and the pulp congeals together. When the pulp has completely dried a sheet of paper is formed and can be peeled off of the screen. The history of the paper making process is extensive and gives insight to how the evolution of the industry to today's modern paper industry. See diagram below.



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<sup>31</sup> Professor Mark Lewis.

### Historical Context of the Paper and Pulp Industry

In order to understand the paper and pulp industry it is vital to explore the historical development of the industry. The historical context of the paper and pulp industry, at Booshoot's request, sheds light on the industry's adaptability and clarifies the role of large paper conglomerates. Booshoot Gardens wants paper manufacturers to use bamboo as a non-wood fiber in the paper making process. Booshoot must understand the history of the industry in order to best shape the future. Author Maureen Smith summarizes the development of the world's paper industry in roughly four historic stages:<sup>32</sup>

- 1) 1<sup>st</sup> century A.D to the 14<sup>th</sup> century. Paper was invented in China and information travel with trade routes, mills first developed in Europe in the 14<sup>th</sup> century.
- 2) 15<sup>th</sup> century: mechanical printing began
- 3) 18<sup>th</sup> century: known for technical innovation
- 4) 19<sup>th</sup> century to present: production processes and commercialization.<sup>33</sup>

Papyrus was the first documented material used to write messages and keep governing documents along the Nile River. Author Louis Stevenson describes the available medium, "papyrus... well established when the art of papermaking became known to Europeans. The raw material of papyrus was a reed."<sup>34</sup> The reeds were cut thin and laid side by side and gummed together to create a sheet. Other material was used to write on including silk, bamboo shoots, bark, etc. Papyrus was the most common medium and even today the word paper is derived from papyrus.

Hundreds of centuries later, Tsai L'un, secretary at the court of the Chinese Emperor Konang-Han is credited with the invention of paper.<sup>35</sup> During the second Han dynasty writing directly on silk was too expensive and bamboo shoots were too heavy to carry. Paper was invented by combining tree bark, hemp, flax, fishing nets, etc. The combination of these products made a thick putty that could be dried and used in sheets.

The next documented development of paper, outside of China, was in Russian Turkestan seventh century A.D. From there cross continental inventions were shared through trade routes. Paper quickly became a highly valued commodity and spread quickly to Europe via Baghdad, Egypt, and Morocco.<sup>36</sup>

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<sup>32</sup> Maureen Smith, *The U.S Paper Industry and Sustainable Production: An Argument for Restructuring*. (London, 1997), 17.

<sup>33</sup> Smith, 18.

<sup>34</sup> Louis Stevenson. *The Background and Economics of American Paper Making*. (New York: Harper and Brothers Publishers, 1940), 1.

<sup>35</sup> Stevenson, 3.

<sup>36</sup> Stevenson, 4 .

The arrival of paper in Europe around the eighth century A.D was important timing because there was a growing population of laborers that could begin to mass produce paper. Paper mills have long histories. The foundation of paper mills in Europe is a significant reason why the European paper industry remains a strong competitor centuries later.

It is important to recognize that without the invention of paper, the first printing press as we know it would have struggled to print in mass because papyrus was difficult to handle and very fragile. Papyrus was hard and brittle and would not have printed uniformly with moveable type. Without the invention of paper, books would have remained a luxury.<sup>37</sup> Paper has played a key role in the spread of literacy.

As paper evolved different fibers were identified that could make strong pulp. Examples include wood, hay, and reeds; see previous sections for the paper making process. Wood fiber comes from chipping a tree or from what is left after a tree is cut into timber. As the timber industry grew, wood fiber became easier to procure.

The demand for paper drove the international industry to use technological advances to produce higher quantities of paper at a faster rate. An example of this is described by author Nancy Ohanian in Spain: "about 1150, papermakers in Xatina, Spain, began to use water power to beat the rags. They extended the axle of the waterwheel, inserted projections in the hub, and used these to pick up and drop a series of hammers. These hammers acted on the water and pulp mixture in a trough until the pulp was beaten to a proper and uniform consistency."<sup>38</sup> Examples such as this show how the demand for paper caused a race for technological advances.

Moving forward on the industry timeline, the first paper mill in the United States was the Rittenhouse paper mill, built 1690 in Germantown, Pennsylvania (near Philadelphia). By 1800, there were 100 small paper mills in the U.S.<sup>39</sup> To this day the mills that have continued to succeed in the United States are those same mills that began in the early 1800s.

The majority of the top 15 mills in the United States have been in existence for over 100 years, making it difficult to enter the industry. The longevity of paper manufacturing firms has a lot to do with the early ownership of tree farms, early addition of multiple stages of the supply chain also known as vertical integration, and prime locations. Historian Nancy Ohanian states, "the early paper mills were located near waterways because water was an important source of power until the adoption of the steam engine in the mid-nineteenth century.... Clean water was also critical to the pulp and

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<sup>37</sup> Stevenson, 5.

<sup>38</sup> Stevenson, 17.

<sup>39</sup> Nancy Ohanian. *The American pulp and paper industry 1900-1940*. (London, Greenwood Press, 1993), 4.

papermaking process, and mills typically were built in rural areas to avoid contaminated urban water supplies."<sup>40</sup> Movement of the paper industry to the southern United States from the Great Lakes Region is due to the available water supplies, "Census reports showed evidence of this relocation as early as 1860, when 53 mills were reported in the West and 24 in the South (although the industry did not become significant in these regions until the 1920s)." In addition to market forces, the relocation in later years was driven by the availability of raw materials in the South and the Pacific regions (see appendix C for graph) .<sup>41</sup>

By 1870, a sharp increase in demand for paper, as well as new technologies and sources of raw material caused the U.S paper industry to rely almost solely on cutting of timber, as the main source of fiber. In the U.S more than 60% of fiber used in paper production was virgin wood, which are new trees cut into chips.<sup>42</sup> This is when the paper industry began to tie itself closely to the timber industry and companies that were able to integrate vertically and independently sourced raw materials succeeded and still continue to thrive today. Examples of vertically integrated companies include the Domtar Corporation, the International Paper Company, Procter and Gamble Paper Products Co., Weyerhaeuser Co, etc.

The next step in technological innovation can be the use of non-wood fibers and the industry's ability to move away from dependency on the timber industry. The paper industry has pushed the world to adapt technology to meet the needs of the people. It is time the industry adapts again to using non-wood fibers. It is important to develop demand however, in order to drive the technological advances that are needed.

To summarize, the paper industry's long-standing tradition of innovation supports Booshoot Gardens' goals of entering the paper industry. It is equally, if not more important, to understand the long history of major players in the industry. The barriers to entry are high and the industry is still dominated by few large corporations. It will be ill advised for Booshoot to consider investing time and resource into entering the paper industry without a committed demand for bamboo from major players in the U.S paper and pulp industry.

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<sup>40</sup> Ohanian, 5.

<sup>41</sup> Ohanian, 5.

<sup>42</sup> Smith, 18.

### Industrial Pulping Process

Now that we understand the historical development of the paper industry, let's look at the modern process. The majority of pulp in the United States is made from virgin wood chips. Wood chips are most often the by-product of cutting logs into timber. On average 80% of a log can be cut into lumber. The other 20% is chipped and used in a variety of functions including paper.<sup>43</sup> Once the chips are made into pulp and arrive at the paper manufacturing facility, the paper making processing can begin.

Pulp is made from binding cellulose fibers and fillers together. Starches and other chemical additives in the pulp are mixed in a digester. The pulping process changes the quality, bleach-ability, and fiber length. These differences make up hundreds of thousands of varieties of paper. The first stage in the pulping process, detailed best by author Gunnar Gavelin is, "the preparation of a furnish or stock- a suspension of fibers and filler particles with some chemicals added. The furnish is homogenized and stored in a machine chest at a controlled consistency."<sup>44</sup> This process is more commonly known as pulping. Chips and chemicals are put through the digester at 170 degrees and made into pulp. See diagram below.<sup>45</sup>

Bamboo chips can perform all the normal functions of wood chips and wood fiber. Any phase mentioned in this section will work for wood fibers and bamboo fibers alike. Commercial manufactures will have minimal need to retrofit machinery.<sup>46</sup>

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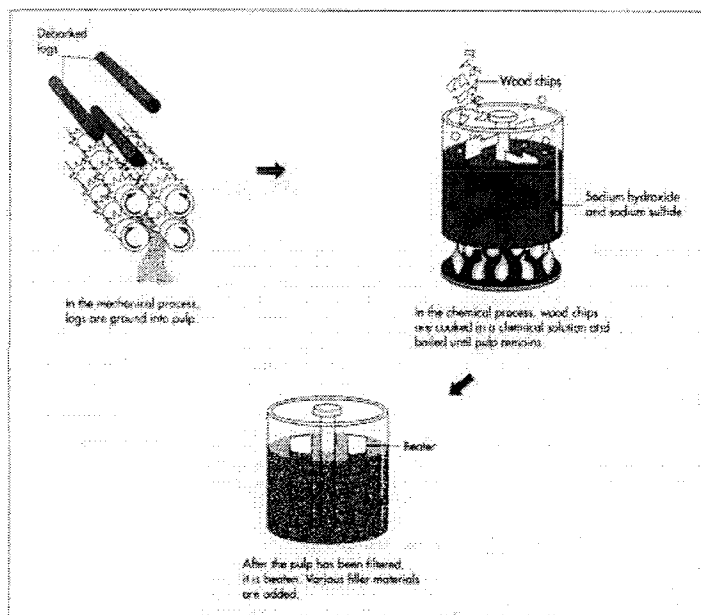
<sup>43</sup> Professor Mark Lewis.

<sup>44</sup> Gunnar, Gavelin, *Paper Machine Design and Operation* (Vancouver: Angus Wilde Publications Inc.,1998), 1.

<sup>45</sup> How it Works. "Manufacturing Paper." <http://www.madehow.com/Volume-2/Paper.html>.

<sup>46</sup> Professor Mark Lewis.





Much of my research focuses on the sustainable qualities of using bamboo instead of wood, but all aspects of the pulping process need to be detailed in order to depict the true carbon footprint of a sheet of paper. The industrial pulping process often receives criticism about the chemicals used. Below are the most commonly used chemicals in the paper making process and their uses. I have also included information about the by-product of pulping to shed light on how the paper industry can move towards being an environmentally conscious industry in more ways than just changing its raw materials.

#### Chemicals Used in Pulp Processing:<sup>47</sup>

- 1) Filler: binds pulp fibers and brightens pulp for ease of dyeing
- 2) Sizing agent: keeps ink from running and changes the absorbency
- 3) Bleach: lightens paper pulp. Commonly thought of as bad for environment, but can be reused again and again throughout the pulp processing.

#### By-Product of Pulp Manufacturing

The by-product of bamboo pulp is called black liquor. It can be put through a membrane separator which breaks down pulp into hemi-cellulose and lignin. The sugars from the hemi-cellulose can be separated further and into simple sugars that can be turned into glycol, a building block in many plastics.<sup>48</sup> Each year the US uses billions of barrels of oil to make plastics, but we can be doing that same work with ethylene-glycol from black liquor. This is another reason why further development of alternative fibers into the paper industry can result in continued benefits to the natural environment. Although,

<sup>47</sup> Professor Mark Lewis.

<sup>48</sup> Professor Mark Lewis.

bamboo does not produce superior black liquor finding more sources of ethylene is significant. There will be continued benefits to supporting alternative fiber sources in the paper industry, finding more sources of ethylene through commercial farming instead of oil drilling is just the beginning.

### Industrial Paper Making Process

In order to understand the paper making process it is important to first define the scale that Booshoot will need to produce, as well as the costs and revenue associated with this endeavor. The following statistics are estimates based on current market conditions. Booshoot will need to commission a study on the costs and revenue projected for this new venture.

The best estimates of costs come from the Technical Association of the Pulp and Paper Industry (TAPPI). TAPPI sets high industry standards and gathers information on leading technological innovations. In order to visualize the scale Booshoot will need TAPPI gives a good visual, "To make 1000-2000 pounds of paper, depending on the processing, it takes a cord of wood which is 8 feet wide, 4 feet deep, and 4 feet high. If that wood is all hardwood (oak, hickory, etc.), the cord will weigh roughly 2 tons, of which 15-20% is water."<sup>49</sup>

The following quantifies the relationship between various stages in supply chain and the costs associated with each stage. Approximated scale Booshoot should be aware of can be described by the following:

- Wood chips are selling for \$100-\$130 a ton and bleached market pulp is selling for approximately \$900/ton with a range of about \$600-\$1000 per ton.<sup>50</sup>
- It takes 2.2 tons of OD chips to make 1 ton of bleached market pulp
- A standard pulp mill will use 4400 tons of bamboo chips per day and 1,148,400 tons per year.<sup>51</sup> This will yield approximately 5060 dry tons of copy paper (based on a 15% filled sheet)<sup>52</sup>
- The average sheet of paper is 80-95% original pulp fiber.<sup>53</sup>

Now that we understand the pulping process and the necessary scale it is important to clearly define how pulp turns into paper. Unfortunately, this is not easy to define because there are many different paper manufacturing processes and paper grades.

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<sup>49</sup> TAPPI. "How much paper can be made from a tree." TAPPI- The Leading Technical Association for the Worldwide pulp, paper, and converting industry. 2001.

[http://www.tappi.org/paperu/all\\_about\\_paper/earth\\_answers/earthanswers\\_howmuch.pdf](http://www.tappi.org/paperu/all_about_paper/earth_answers/earthanswers_howmuch.pdf).

<sup>50</sup> Professor Mark Lewis.

<sup>51</sup> Professor Mark Lewis.

<sup>52</sup> Professor Mark Lewis.

<sup>53</sup> TAPPI.

### Steps in the Paper Making Process<sup>54</sup>

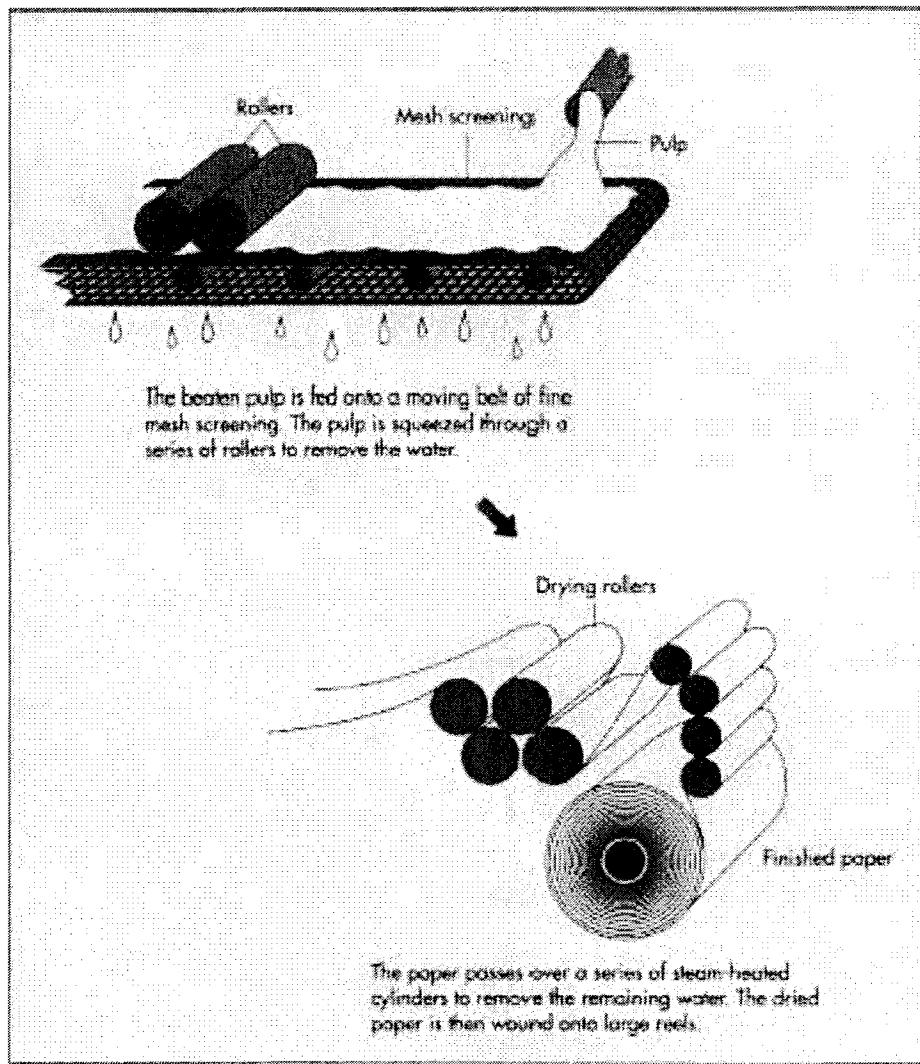
- 1) Wet end: Start with pulp and water, 1% pulp fiber and 99% water
- 2) Head Box: Pulp moves along the mesh wire and the water begins to strain out
- 3) By the end of the wire the pulp has been strained from 99% water to 80% water
- 4) Press section: pulp is pressed to 60% water.
  - a. The importance of this process is best detailed by author Gunnar Gavelin, "During pressing a new force comes into play at about 40% dryness, known as hydrogen bonding. Fiber surfaces are pressed close enough together that the oxygen atoms of hydroxyl groups protruding from adjoining surfaces come within a distance of 2.5-3.5 Å to one another. In this situation two oxygen atoms can share a proton of a hydrogen atom. In effect, the hydrogen atom cannot choose between the two oxygen atoms, thus producing a hydrogen bond."<sup>55</sup>
- 5) Dryer Section: The pulp is sent through the dryer on large metal or plastics rollers and dried to 5% water
- 6) This stage in the process is called market pulp. This can be shipped all over the world in flat dry sheets that can be easily turned into paper. The next stages have numerous variations.
- 7) Calendar Section: this stage smoothes market pulp to the right thickness and weight. Depending on the type of market pulp some water may be added again to agitate the pulp and make it easier to smooth. A company with a lot of vertical integration can skip costly steps between the drying and calendar sections which are required by strict manufacturing facilities.
- 8) Coding Section: here various latex and pigments are applied to change paper variety
- 9) Cutting Section: large paper sheets are then cut into the desired dimensions
- 10) See photos and detailed paper manufacturing processes in Appendix A.

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<sup>54</sup> Professor Mark Lewis.

<sup>55</sup> Gavelin, 3.

Below is a simplified diagram of the paper making process



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<sup>56</sup> How it Works. "Manufacturing Paper." <http://www.madehow.com/Volume-2/Paper.html>.

## The Paper Industry in the U.S

The industrial paper manufacturing process is different than understanding how companies compete in the industry. This next section will detail the rules to profiting in the U.S paper industry. The paper industry is a global industry, but the U.S provides a framework for understanding how companies compete within the industry. Booshoot hopes to compete as a raw material provider, but the industry is complex and there are many potential buyers for Booshoot's product, all with distinct needs and manufacturing capabilities.

The first important characteristic of the paper industry is that there are two different organizational systems for making paper. The first is a non-integrated system in which a separate company performs each step in the supply chain. The second is an integrated system which is a company that takes on more than one stage of the supply chain. The more integrated a company the lower the costs and therefore the more competitive the product to wholesalers. An integrated company enjoys lower overall manufacturing costs.<sup>57</sup>

When paper processing first took off in the United States each company specialized in a different part of the supply chain, also known as a standard non-integrated system. The many steps in a non-integrated system are described below:

- 1) Seed Cultivator: seeds or trees starts are provided to timber companies and/or farmers. The first stage of a supply chain has the lowest contribution margins. In the paper industry the mark-up is always less than 10%.<sup>58</sup>
- 2) Farmer: Raw material cultivation and chipping. Pricing in this stage ranges from \$100 to \$130 per ton of wood chips.<sup>59</sup> These are average prices based current market conditions. Profit in this industry is based on how many tons of wood chips a farmer can sell. Booshoot will make more at this stage than as a company which sells bamboo starts.
- 3) Pulp Mill: Processing of wood chips and chemicals into market pulp. Market pulp is light, flat, dry, unrefined pulp that is processed further into paper. The average large commercial U.S pulp mill produces between 1-3 million tons annually.<sup>60</sup>

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<sup>57</sup> Carlsson, Dick. "Paper Supply Chain Management." Interuniversity Research Center on Enterprise Networks, Logistics and Transportation. Universite Laval. Quebec, Canada.

<sup>58</sup> Urmanbetova, Aselia. *U.S Pulp and Paper Industry*. School of Economics at Georgia Institute of Technology. Atlanta Georgia.

<sup>59</sup> Global Trade, Inc. "Price of Wood Chips." 2010. <http://www.alibaba.com/showroom/wood-chip-for-pulp.html>.

<sup>60</sup> FOEX Indexes Ltd. "The Pix Pulp Benchmark Indexes) per metric ton." Paper Age. 2010. <http://www.paperage.com/foex/pulp.html>.

The average price of a ton of pulp in 2009 was between \$600-1000 per ton.<sup>61</sup> Incoming revenue would be higher if Booshoot could process bamboo pulp. However, I do not recommend Booshoot become a pulping company because the start-up costs are high. Many paper manufacturing firms are also making their own pulp. Booshoot would have a hard time competing as a pulping company.

- 4) Paper Mill: Purchases market pulp and refines pulp into large rolls of paper. The reel may be 5-10 meters wide and 30km long. Cutting is challenging because customer orders are for products that may be .5-1.0 meter wide and 5 km long.<sup>62</sup> Fixed costs are usually 30-40 percent of total production costs, which is why the contribution margin is higher with a more integrated company.<sup>63</sup>
- 5) Paper Manufacturer: Purchases large roles of paper and cuts the paper into sheet that the end user will purchase. The manufacturer also brands the product at this stage. Sometimes further coding and coloring is done to meet the specifications of the consumer. The paper is then packaged and sold to wholesalers.
- 6) Wholesaler: Warehouses and delivers to retailers.
- 7) Retailer: Sells directly to the individual consumer or institution.

There are numerous business models in the paper industry. The organization with the fewest costs is a fully integrated mill, as shown in the diagram below.<sup>64</sup> A fully integrated mill goes from a firm's supply of raw material to a sheet of paper all within the confines of a single company. This structure reduces shipping and overhead costs that are incurred when a new company owns each stage of the supply chain.

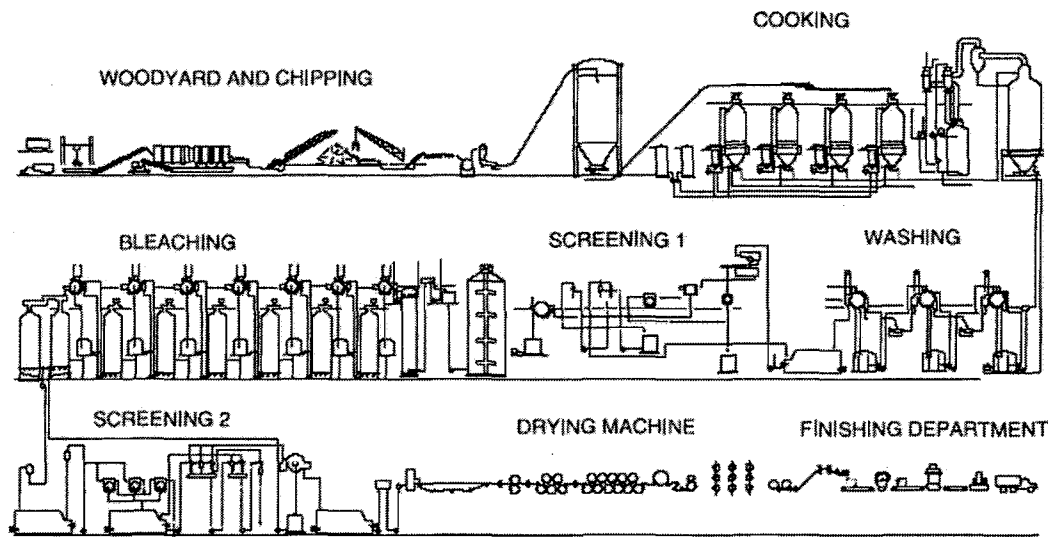
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<sup>61</sup> Hardwick, John. "Botnia to hike pulp prices." 2010. <http://www.pulpapernews.com/2010/02/botnia-to-hike-pulp-price>

<sup>62</sup> Carlsson, Dick. "Paper Supply Chain Management." Interuniversity Research Center on Enterprise Networks, Logistics and Transportation. Universite Laval. Quebec, Canada.

<sup>63</sup> Urmanbetova, Aselia. U.S Pulp and Paper Industry. School of Economics at Georgia Institute of Technology. Atlanta Georgia.

<sup>64</sup> "Paper and Pulp Industry: Case Study," accessed August 20<sup>th</sup> 2010, [www.balticuniv.uu.se/ConfPres/.../cp/Pulp\\_and\\_paper\\_industry.ppt](http://www.balticuniv.uu.se/ConfPres/.../cp/Pulp_and_paper_industry.ppt)



Booshoot could sell bamboo starts to the farmer, but Booshoot is looking to bring in more revenue than its current horticulture business. The best way to increase Booshoot's profitability is to find a way to grow bamboo to maturity and sell bamboo chips. Bamboo chips like wood chips could be sold to a pulp mill or a fully integrated paper mill that has a pulping facility on site.

If Booshoot expands its business it could also sell full grown bamboo shoots or chips to an integrated mill. Bamboo is a new raw material to the paper industry and until fully integrated mills grow their own bamboo they will still need to purchase bamboo from a company like Booshoot.

A good example of a large paper manufacturer is Longview Fibre. This company has 5 paper machines and each machine makes a different line of paper. Some lines can run at 2,900 ft/min, up from 2000 ft/min in 2007. The average line produces 164,000 tons of pulp and linerboard per year. The mill in total can produce 1.6 million tons/yr of pulp and 1.3-1.6 million tons/yr of paper: kraft and corrugated. Booshoot should be prepared to supply raw material for a smaller line in a large company, which in the case of Longview Fibre would be around 164,000 tons of pulp annually.<sup>65</sup> If Booshoot were to cultivate enough chips for an entire standard pulp mill Booshoot would need to provide up to 4400 tons per day, equivalent to 1,148,400 ton/yr for a large pulping facility.<sup>66</sup>

### Downstream Demand

<sup>65</sup> Rodden, Graeme. "Longview Fibre has enjoyed a remarkable turnaround since Brookfield purchased the assets in 2007." Pulp and Paper International. April 2010.

<sup>66</sup> Professor Mark Lewis.



An important characteristic of the paper industry is that the demand at the end of the supply chain changes the decisions of all stages, even raw material suppliers—this is called downstream demand. The end user in the paper industry ranges from large institutions to the individual. The pull from downstream demand is vital in this industry. When researching market conditions the best source is IBISWorld, a leader in developing industry analyses. According to IBISWorld, “The level of activity in these downstream industries will generally dictate demand for paper rolls, with an increase in manufacturing output being favorable for paper manufacturers.”<sup>67</sup> The state of downstream demand causes significant shifts at each stage of the supply chain listed above.

For example, if bamboo paper is cheaper and functions well in a variety of end products demand for bamboo paper motivates paper and pulp mills to purchase bamboo as a raw material. IBISWorld goes on to say, “The level of demand in these downstream industries is influenced by macro factors, including business activity in the country, consumer and business sentiment, the general state of the economy, and the level of import penetration in each respective downstream industry.”<sup>68</sup> Booshoot needs to partner with a company that values strong marketing strategies to continue to pull demand through and thus provide Booshoot with a long term position in the paper industry.

#### Key Success Factors:<sup>69</sup>

Other than downstream demand there are also alternative key success factors in the paper industry. IBISWorld details the key success factors in the U.S paper industry and further analysis is listed below.

**Guaranteed supply of key inputs:** Contracts for the supply of wood pulp will ensure that a paper producer has access to the necessary quality and quantity of raw material required. This will be discussed in future sections.

**Automation – reduces costs, particularly those associated with labor:** Installation of state-of-the-art technology to improve plant efficiency and reduce costs will not only give a producer a financial advantage but also a marketing advantage, through the use of clean, green technology.

**Economies of scale:** Larger scale mills will be able to achieve cost competitiveness with major domestic and foreign producers.

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<sup>67</sup> Lekovic, 17.

<sup>68</sup> Lekovic, 17.

<sup>69</sup> Lekovic, 25.

**Having contacts within key markets:** Links with user industries are paramount to ensuring a continuous demand for the output produced.

**Undertaking technical research and development:** Research and development will maximize the possibility of developing higher quality products with faster production schedules.

**Ability to alter goods and services produced in favor of market conditions:** The type of market supplied, with printing and stationery products offering higher returns, is important since demand changes with business cycles and major foreign producers have the ability to quickly switch production between end products.

Out of the 6 key success factors the most important for Booshoot Gardens are the guaranteed supply of key inputs.<sup>70</sup> Booshoot will need to provide a guaranteed supply to pulp manufacturers. It is good that bamboo is resilient to most diseases and grows at a standard rate. Although, finding the right bamboo to be harvested and chipped annually will be vital to pulp manufacturers who need a guaranteed supply.<sup>71</sup>

Booshoot needs to find a variety of bamboo with a fiber length that can be used in making paper. The height and speed of growth are also defining factors on the ideal bamboo type. Manufacturers need pulp that can be used in a variety of products. For example, Booshoot could commission a study from the University of Washington to find bamboo with versatile fibers, thus providing the perfect raw materials for key success factors in the paper industry. Other strong universities with paper engineering departments include: Miami University in Ohio, SUNY College of Environment Science and Forestry in New York, and Western Michigan University in Kalamazoo. The University of Washington is the closest program to Booshoot Gardens and none of the other top paper engineering programs are located in the southeast.

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<sup>70</sup> Lekovic, 25.

<sup>71</sup> Phil Ferranto, interview with author. Booshoot Gardens. August 17<sup>th</sup> 2010.

## Bamboo in Paper Production

Now that I have defined the competitive context of the industry it is time to discuss how bamboo as a new fiber source will succeed in the paper industry. Below you will find what is unique about bamboo, the benefits, and the limitations, and the implications for bamboo and Booshoot Gardens in the paper industry.

### Non-Wood Fibers

Many non-wood fibers can be processed into pulp for paper today (see appendix A). Examples include: bamboo, wheat straw, giant reed, *Arundo Donax*, and seed alfalfa.

There are many benefits to using a non-wood fiber. Currently, the paper industry uses at least 90% wood chips for its fiber source. Wood chips are the by-product of the timber industry. Although the timber industry is subsidized by the government, support is declining constantly, which means costs will continue to rise. The timber industry receives .1% of the agriculture subsidies in the U.S.<sup>72</sup> Bamboo is not subsidized, but farmers who are losing their crop subsidies every year are looking for a crop whose potential is growing. Bamboo is a global \$10 billion a year industry and the United States is the #1 importer of bamboo in the world.<sup>73</sup> There are also other subsidies that commercial farming of bamboo may qualify for. Further research needs to be done to find how bamboo can qualify for environment subsidies, especially because a stock of bamboo releases 35% more oxygen into the air than a small tree.<sup>74</sup>

The paper industry should move away from a dependency on an industry that is highly regulated and drastically fluctuates with changes in other industries. IBISWorld states, "In the five years to December 2010, IBISWorld expects that the volume of ground wood removed for industrial production will decline at an average annual rate of 6.5%."<sup>75</sup> Although the timber industry is a billion dollar industry the trend is still volatile and declining. IBISWorld also states, "The industry has declined in recent years due to weakening demand for logs from the drop in housing demand. Demand for pulping logs fell as downstream wood pulp manufacturers responded to weaker demand for paper and paperboard products, and as the paper sector within the US implemented large-scale capacity reductions."<sup>76</sup> The regulations on the timber industry and the high costs of replanting and cutting forests have steadily increased the price of wood chips.<sup>77</sup> With

<sup>72</sup> The Environmental Work Group. "Agriculture Subsidies 2009." January 2010. <http://farm.ewg.org/>

<sup>73</sup> Bamboo Now. "Facts about Bamboo." Bamboo Now: a union of bamboo specialist (including Booshoot Gardens). 2009. [http://www.bamboonow.us/pages/facts/facts\\_main.asp](http://www.bamboonow.us/pages/facts/facts_main.asp)

<sup>74</sup> Bamboo Now.

<sup>75</sup> 5. Allday, Alen. "Logging In the U.S." *IBISWorld Industry Report*. No. 11331 (June 2010).

<http://www.ibisworld.com.libproxy.uoregon.edu/industryus/default.aspx?indid=78>.

<sup>76</sup> Alen Allday. "Logging in the U.S.,"5.

<sup>77</sup> Alen Allday. "Logging in the U.S.,"5.

alternative raw materials the paper industry can move away from relying on the unstable timber industry.

Alternative fibers also increase employment in the agriculture industry, while protecting forests which are a more fragile eco-system. Non-wood fibers are often more sustainable, bamboo for example uses less water and pesticides. Many non-wood fibers are also less susceptible to diseases.

### Bamboo Fiber

Bamboo fiber functions the same as wood fiber in pulping and paper manufacturing.<sup>78</sup> Different types of bamboo have various fiber lengths which function differently when exposed to chemicals. It will be up to Booshoot Gardens to find the right bamboo to work in traditional paper mills.<sup>79</sup> Bamboo fibers that are too short may not hold up in the paper making process, but bamboo fibers that are too long may not respond to traditional paper processing. With the right bamboo commercial farmers will have very little costs associated with retrofitting machinery.

### Why is Bamboo Unique

Bamboo is a dense fiber that can be chipped similar to wood. Bamboo takes three years to grow to maturity, but it regenerates itself so a third of a crop can be cut every year to keep a sustainable annual harvest. Wheat straw and grasses are light and difficult to load onto a long conveyer belt; as Professor Lewis says, "it is very hard to convey feathers."<sup>80</sup> Giant reed and arundo are great non-wood fibers, but bamboo in some areas of the world thrives better. Bamboo is special because it is a perennial grass that can be commercially grown so there are fewer costs associated with replanting. Bamboo is an excellent non-wood fiber option and Booshoot Garden has the ability to mass-produce bamboo starts for large scale production. It is important to clarify that bamboo is not the only non-wood fiber that can work in paper manufacturing, but bamboo has a lot of important qualities that make it a great non-wood fiber source.<sup>81</sup>

### Benefits of Bamboo:

- Bamboo is a top choice when choosing a non-wood fiber as mentioned above.
- Bamboo is more resilient to rust and insects than trees, which means less pesticide is needed. For example, the white pine beetle is destroying the white pine which is a staple in the Canadian paper industry, but this beetle does not affect bamboo.

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<sup>78</sup> Professor Mark Lewis.

<sup>79</sup> Phil Ferranto.

<sup>80</sup> Professor Mark Lewis.

<sup>81</sup> Professor Mark Lewis.

- A grove of bamboo takes in 4 times as much carbon dioxide than a grove of trees and releases 35% more oxygen into the air.<sup>82</sup>
- Bamboo is a low cost crop due to low maintenance. It takes about a third less water to produce an acre of bamboo than it does to grow an acre of hybrid-poplar.<sup>83</sup>
- Bamboo is a perennial crop that farmers don't need to field burn or re-plant in order to continue bamboo cultivation.<sup>84</sup>
- Less fertilizer is also used. Bamboo cannot be fertilized in the first year and low fertilizer is added as the bamboo reaches maturity.
- Bamboo is a commercially viable way to make paper without being dependent on the timber industry.
- Bamboo can be grown close to the pulping facility because pulp mills in the southeast are surrounded by farm land, not forests. Bamboo could easily be grown on land that once grew tobacco or cotton, crops that are no longer thriving in the U.S. As long as there is land available bamboo can be grown close, which means lower carbon emissions in the transportation of fiber.
- If grown and produced in the U.S. bamboo paper can be marketed as a Made In The U.S environmentally sustainable product. The right marketing could appeal to consumers who will pay a premium.

#### Limitations of Bamboo

- Bamboo has a high silica content which means that it is harder to chip than most woods. It may be necessary to sharpen or replace blades more than cutting trees, this would need to be researched further.
- Pulp and paper manufacturing are not starving for a new fiber source, especially if bamboo is not significantly cheaper to cultivate and chip.
- There is a stigma that bamboo is invasive and farmers will have to be educated on the benefits of bamboo to be persuaded to grow it.
- Bamboo varieties need to be tested in order to find the right fiber length.
- The right marketing has to be done in order to compete with recycled paper. It takes more chemicals to remove dye and process recycled paper, but consumers may not understand that and decide to choose recycled paper over bamboo because bamboo is still a virgin fiber.

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<sup>82</sup> Bamboo Now.

<sup>83</sup> Professor Mark Lewis.

<sup>84</sup> Phil Ferranto.

### Implications for Booshoot Gardens

Because paper is so responsive to downstream demand, it is vital that Booshoot Gardens considers the needs of the consumer when attempting to enter the paper and pulp industry. Value for a consumer comes from a product being differentiated from a competitor's product. Differentiation can come in three main ways:

- 1) The product functions the same for a lower cost
- 2) The product has a superior function for the same reasonably similar costs
- 3) The product has a desirable image or other intangible benefits.

For cost-conscious consumers bamboo may cost less to cultivate and the saving could be passed on to the consumer. However, because cultivation is early in the supply chain, the savings may not be passed onto end user. For environmentally conscious consumers bamboo paper can be marketed as a product with a smaller carbon footprint than recycled paper.

Bamboo has the potential to succeed in any one of the three ways listed above, but it will be important to ensure that Booshoot Gardens works with leaders in the industry to market products successfully in order to achieve clear and effective differentiation from the competition.

### Industry Analysis

I have described how paper is made and how the larger paper and pulp industry functions, now I will break down the paper industry into small segments. The paper and pulp industry is an overarching term which covers many smaller industries. In order to best understand industry conditions facing Booshoot three industry reports are analyzed:

- 7) Paper Mills in the U.S
- 8) Wood Pulp Mills in the United States
- 9) Sanitary Paper Product Manufacturing in the U.S.

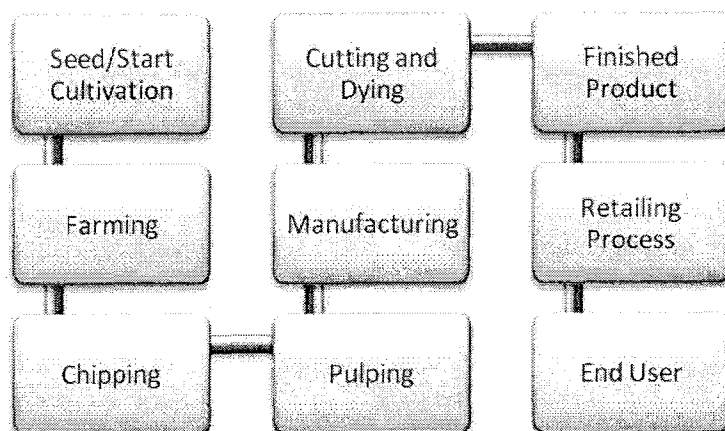
These reports were chosen because the current climate of paper manufacturing, pulp mills, and sanitary paper are the three smaller industries that most directly affect Booshoot Gardens. Each industry depicts different components of the larger paper and pulp industry and help to define the ways Booshoot can be successful in a new industry.

Booshoot specializes in cultivating bamboo starts, or young bamboo plants. Booshoot's tissue culture process is unique in that Booshoot can cultivate a million bamboo starts a year. Bamboo does not create a seed and therefore it is challenging to grow large amounts quickly. It is possible to make paper out of bamboo with little retrofitting of the paper manufacturing process. In order to confirm assumptions about Booshoot's potential success in the paper industry, an analysis of the market conditions will confirm whether the industry can support this new venture.

By utilizing the information from multiple sectors of the industry Booshoot can have a comprehensive understanding of the challenges at each stage of the supply chain and the complex cost structure. Multiple levels of analysis also help to piece together additional costs that could change Booshoot's profitability.

### Paper and Pulp Industry Supply Chain

The first step in understanding market conditions is to remember the U.S paper industry supply chain also known in this industry as a non-integrated manufacturing process.



Many companies and small industries interact to make a piece of paper. The diagram above charts the phases in the paper and pulp industry supply chain. The paper industry has a continuum of degrees of integration.<sup>85</sup> The more integrated a company the more stages it performs. When done well, integration is more profitable. That is why I am recommending that Booshoot take on the growing and chipping phases of the supply chain. In the seed production phase a supplier will never receive a mark-up above 10%. In the pulping stage there can be over a 40% mark up. The exact contribution margins change for different qualities of paper and Booshoot should commission further research in order to project revenue clearly.

### Booshoot's Objective

Booshoot's objective is to sell its bamboo to a company in the paper industry. Booshoot should chip and sell its bamboo to a paper manufacturing company wishing to make paper out of bamboo. One market may be stronger than another, but Booshoot should not limit itself to a specific buyer this early in the game. Booshoot should go after partnerships with strong industry leaders.

### Leading Raw Material

The majority of raw material in this industry is wood. Wood chips are a by-product of the timber industry. This report will cover three industries that have the ability to use alternative raw materials. The regulations on the timber industry and the high costs of

<sup>85</sup> 4.Smith, Maureen. *The U.S Paper Industry and Sustainable Production: An Argument for Restructuring*. London: Massachusetts Institute of Technology Press, 1997.



replanting and cutting forests have steadily increased the price of wood chips.<sup>86</sup> With alternative raw materials the paper industry can move away from relying on the volatile timber industry.

### Downstream Demand

It was mentioned previously that in the umbrella paper industry downstream demand is important, this is true with individual markets as well. Downstream demand is pressure the end user places on the products made in the industry. In the case of the paper industry downstream demand is the type and amount of paper purchased by the end user. Booshoot can sell its product at any stage of the supply chain, but in this industry all the stages are affected by what comes after it.

Booshoot can sell its product to farmers who would then grow bamboo to full size, but this would not expand its business outside of its current horticulture business. Booshoot is looking to bring in a greater source of revenue. The most lucrative option for Booshoot is to grow its starts to maturity and become a sole provider to a larger manufacturing firm. However if Booshoot chooses to enter the paper industry it has to work with paper manufacturers who are committed to making paper out of bamboo. If pulp manufacturing companies refuse to purchase bamboo in place of, or in addition to virgin wood, then Booshoot cannot succeed in the paper and pulp industry.

### Differentiation

Downstream demand is a key success factor, but Booshoot also brings a differentiated product that can add value to the paper industry. There are three points of differentiation that would encourage a paper company to add an alternative fiber to process. These three points of differentiation can be described through three simple questions:

- 1) Is the new product cheaper
- 2) Does the new product function better
- 3) Is there an image associated with the new product encouraging the buyer to purchase the product at a higher price point.

Commercial farming of bamboo can cut costs compared to owning forests and thinning trees. Growing bamboo would also be cheaper than commercially farming a grove of hybrid-poplar which is the closet equivalent to farming groves of bamboo. Bamboo is also more sustainable to grow and bamboo allows the paper industry to move away from the timber industry. Change in the traditional wood fiber is a risk and points of differentiation have to be well advertised in order to drive the necessary downstream demand.

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<sup>86</sup> Allday, 5.

**Key Statistics:**

The big picture context has been described, but it is the individual markets that have to provide opportunity for Booshoot to succeed not simply in theory, but in practice. The following chart is a snapshot of the three markets Booshoot will be entering.

| <b>Industry</b>                         | <b>Wood Pulp Mills U.S.<sup>87</sup></b>  | <b>Sanitary Paper U.S.<sup>88</sup></b>   | <b>Paper Mills U.S.<sup>89</sup></b>   |
|---|---|---|--|
| <b>Annual Growth 05-10</b>              | -1.0%   | -1.1%   | -3.6%  |
| <b>Projected Annual Growth 10-15</b>    | 2.1%  | 0.6%  | -1.5%  |
| <b>Revenue</b>                          | \$4.6 billion   | \$25.4 billion  | \$32.7 billion   |
| <b>Profit</b>                           | \$32.4 million  | \$2.6 billion   | 261.2 million  |
| <b>Exports</b>                          | \$3.9 billion   | \$3.0 billion   | 5.2 billion  |
| <b>Competition Level</b>                | Medium  | High  | Medium   |
| <b>Barriers to Entry</b>                | High  | Medium  | High   |
| <b>Businesses</b>                       | 29  | 219   | 297  |
| <b>Lead Businesses and Market Share</b> | Weyerhaeuser Company 16.7%<br><br>International Paper Company 13.5%<br><br>Domtar Corporation 11.5% | Kimberly-Clark Corporation 39.9%<br><br>Koch Industries, Inc. 27.5%<br><br>The Procter and Gamble Company 21.3% | Domtar Corporation 9.0%<br><br>International Paper Company 8.9%<br><br>NewPage Corporation 8.7%<br><br>AbitibiBowater Inc. 6.6%<br><br>Boise Inc. 4.8% |

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<sup>87</sup> Lekovic, 2.

<sup>88</sup> Lekovic, 2.

<sup>89</sup> Lekovic, 2.

## Implications

There is a real opportunity in this market. The wood pulp industry has the greatest projected growth of all three industries at 2.1% 2010-2015. The wood pulp industry is also the smallest industry of the three with \$4.6 billion in revenue compared to the sanitary paper industry at \$25.4 billion and the paper mill industry at \$32.7 billion. It is important to consider the larger industries because the downstream effect of other markets in the industry have heavy influence on the selling price of pulp and thus the profitability of Booshoot. IBISWorld notes, "Revenue from domestic customers is highly reliant on the performance of downstream industries such as paper converting, publishing and printing."<sup>90</sup> If there is a strong niche market in paper made from bamboo then maybe more downstream companies will purchase the associated pulp and paper. It will be important to create demand from the end user which will encourage downstream industries to buy.

The concentration of these industries is an important indicator for Booshoot. There are far fewer companies to work within the wood pulp industry. This is due to many manufacturing companies choosing to produce their own pulp. Concentration within the paper manufacturing industry is growing and it is vital to get the interest of large enterprises. IBISWorld notes, "Over the five years to 2010, three previously large players left the industry by selling assets to smaller companies, resulting in larger market share for the remaining firms. Market share concentration grew from 28.5% in 2005 to 33.3% in 2010, indicating a trend towards more market power for larger enterprises."<sup>91</sup> With concentration increasing and barriers to entry high across the board it will be vital for Booshoot to develop partners within the industry.

Based on the market projections I recommend that Booshoot grow bamboo to maturity, process it into chips that a pulp or integrated paper manufacturer would buy, and prioritize partnerships with the growing pulp industry and integrated sanitary paper manufacturers. These markets have the greatest potential. The following sections will detail the opportunities and limitations of each individual market.

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<sup>90</sup> Lkovic, 5.

<sup>91</sup> Lkovic, 5.

### Industry Specific Qualities: Wood Pulp Mills

Definition: The Wood Pulp Manufacturing Industry is described by IBISWorld as, "Wood Pulp Mills primarily manufacture pulp without processing it into paper or paperboard. The pulp is made by separating the cellulose fibers from impurities in wood or other materials, such as used or recycled rags, scrap paper and straw. Pulp which is sold to other manufacturers (not processed into paper in the same facility) is referred to as market pulp."<sup>92</sup>

### Opportunities

Of the 29 businesses in this industry, 21 are located in the southeastern region of the United States. Booshoot has the capability to mass produce native bamboo starts in the southeast. These plants would be more resilient to climate conditions than a non-native tree in that region and thrive in commercial farming.<sup>93</sup> Currently timber and wood chips are shipped in from forests all over the country. The closer the fiber source, the cheaper the paper because transportation costs are high. Pulp manufacturers in the south are surrounded by agricultural crops. This is an opportunity to plant a fiber source closer to the manufacturer than even local forests.

The pulp industry is expected to continue to grow in other ways. IBISWorld states, "Sales of other types of pulp by American pulp mills are estimated to have grown from 11% of industry revenue in 2004 to 14.3% in 2009," due to growing usage of recycled material and alternative non-wood fibers.<sup>94</sup> This is possibly a sign that Booshoot may be entering into a niche market at the right time.

### Threats

As pulp production becomes more costly and large paper conglomerates are attempting to produce their own pulp, this industry is looking globally to remain profitable. IBISWorld states, "The industry has struggled to remain profitable, as domestic markets typically provide pulp millers with higher prices than export markets. Pulp mills have also faced great increases to input costs over the past five years."<sup>95</sup> These struggles also affect individual company earnings.

As competition grows stronger the domestic industry struggles and IBISWorld states, "Companies have to remain price wary in order to achieve sales. This puts pressure on the bottom line, particularly when input costs are growing."<sup>96</sup> The pulp industry acts as a middle man between raw materials and paper mills and in turn makes this industry

<sup>92</sup> Lekovic. "Wood Pulp Mills in the US," 2.

<sup>93</sup> Professor Mark Lewis

<sup>94</sup> Lekovic. "Wood Pulp Mills in the US," 13.

<sup>95</sup> Lekovic. "Wood Pulp Mills in the US," 4.

<sup>96</sup> Lekovic. "Wood Pulp Mills in the US," 9.

extremely price conscious to remain profitable. Cost volatility is very hard on this industry. What is important to remember is that although the U.S production of wood pulp has fallen over the last year, it does not mean this is an industry to shy away from because it has the greatest projected growth.

### Implications

Selling bamboo to the pulp industry is the simplest way for Booshoot to enter into the paper industry.

- The wood pulp industry is small but has great potential for growth. If Booshoot can find a partner that focuses on raw material cultivation and pulping, Booshoot could easily supply bamboo.
- This industry performs functions closest to the ideal functions of Booshoot. Booshoot will have the greatest profitability if it can find ways to grow bamboo to maturity and sell it to the pulp industry. This industry should not be underestimated.
- The wood pulp industry is heavily concentrated in the southeastern portion of the United States. Booshoot has the ability to grow native bamboo in the Southeast, a product more resilient to non-native alternative fiber sources.<sup>97</sup>

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<sup>97</sup> Phil Ferranto.

### Industry Specific Qualities: Paper Mills U.S

Definition: Paper mills in the United States are described by IBISWorld as, "Operators in this industry run paper mills where they manufacture paper from pulp and recycled materials. Industry products include paper rolls and reams (including newspaper) which are sold to downstream manufacturers of paper products, such as coated/treated paper, stationery, paper bags, newspaper/ magazine publishers, printing services, sanitary paper, and others. Mill operators may manufacture their own pulp or purchase it from pulp mills."<sup>98</sup>

### Opportunities

The best opportunity in this industry is the size and versatility of paper mills. The major opportunity for a smaller company like Booshoot is to work with firms that create paper for growing industries like the sanitary paper industry. At this time companies are quite large and often have pulp manufacturing facilities which Booshoot could consider working with directly. Bamboo fiber can be used just the same as wood fiber. It is important to recognize that demand is driven by the end user. Bamboo will provide paper manufacturers with an image of sustainability and Booshoot should continue to sell its image just as much as the product itself.

If Booshoot wants to enter this industry it will be important to look globally for a buyer as well. IBISWorld states, "Despite being the second largest producer of paper in the world, the US is a net importer of the same. Imports are nearly double that of exports, however, the trade deficit has shrunk over the five years to 2010. Domestic producers have taken advantage of the weak US dollar over the same period, which has made US exports relatively cheaper."<sup>99</sup> Paper, paper products, and pulp are imported and exported constantly. Booshoot needs to decide whether it will partner with companies who do not have the same environmental standards. If a company buys bamboo from Booshoot, but then sells it to a company that makes paper in a way that damages the environment of a foreign country, Booshoot needs to decide whether it will continue to work with that company.

### Threats

Of all three industries the paper manufacturing industry will struggle the most in coming years. The United States was once the leader in the paper mill industry. Less expensive labor costs abroad, stringent government regulations, and environmental standards are all reasons US companies are struggling and the competition can succeed in producing paper overseas.<sup>100</sup> The US is no longer the world's largest producer of paper. Chinese

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<sup>98</sup> Lkovic, 2.

<sup>99</sup> Lkovic, 9.

<sup>100</sup> Lkovic, 4.

companies took over paper output during 2008, producing only 16.9% of the world total, followed by U.S companies at 16.4%.<sup>101</sup>

The major challenges in the industry are as follows: "Industry value added is declining, while the economy as a whole is growing. The number of industry operators is declining and market share concentration is increasing. Paper varieties and grades are clearly segmented and stable, and any innovation is mainly cosmetic. Demand has been declining, mainly due to reduced advertising in print media and diminished manufacturing activity."<sup>102</sup>

The numbers in the paper mill industry have been dragged down by the quickly declining newsprint industry.<sup>103</sup> According to an IBIS World Report on the Newsprint Industry, "Newspaper publishers are facing escalating competition from other forms of media, particularly web-based media. As a result, advertisers are spending less money on print and more on the internet... Over the five years to 2010, Newspaper Publishing industry revenue is expected to decline at an annual rate of 6.0% to \$40.73 billion. Revenue in 2010 is estimated to decline 3.2% as newspaper publishers continue to lose audiences and advertisers to other media."<sup>104</sup> This industry has components that are struggling but the paper mill industry is still the largest of the three industries discussed here. Booshoot should not shy away from working with paper mills that make paper for other growing industries, but Booshoot should stay away from working with firms that focus heavily on newsprint as that medium is steadily declining.

### Implications

The paper mill industry is not growing, although this is a large industry with a lot of vertical integration and should not be ignored.

- The paper mill industry is the largest of the three industries. Vertical integration is high and Booshoot will need to find ways to sell directly to the paper mill.
- Booshoot should work with paper mills that make paper for growing industries so Booshoot can have a better chance of a long term partnership.

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<sup>101</sup> Lkovic, 4.

<sup>102</sup> 9. Lkovic.

<sup>103</sup> Professor Mark Lewis.

<sup>104</sup> 5. Kaczanowska, Agata. "Newspaper Publishing in the U.S." *IBISWorld Industry Report*. No. 51111 (August 2010). <http://www.ibisworld.com.libproxy.uoregon.edu/industryus/default.aspx?indid=1231>.

### Industry Specific Qualities: Sanitary Paper U.S

Definition: The sanitary paper production industry as described by IBISWorld; "Industry operators convert sanitary paper stock or wadding, as well as pulp and paper, into sanitary paper products such as facial tissues and handkerchiefs, table napkins, towels, toilet paper, disposable diapers, sanitary napkins, tampons and others. Some operators may manufacture their own sanitary paper while others purchase it from mills. Final industry products are sold to wholesalers for distribution, straight to retailers or directly to large customers."<sup>105</sup>

### Opportunities

This is an industry that thrives in a country that values sanitary products. The United States is the world's largest manufacturer and consumer of sanitary paper products in the world. Per capita consumption of sanitary paper goods far surpasses any other country.<sup>106</sup> IBISWorld states, "Domestic consumption of tissue paper in the U.S. totals almost 27 kg per capita annually, compared with a worldwide average of only 3.9 kg. U.S. production is estimated to account for approximately 23% of the world total in 2010. This is a decline from 26.8% in 2005, due to rapid developments of the paper industries in emerging economies, particularly China."<sup>107</sup>

It will be important to Booshoot to work with major players in the industry in order to find a resilient revenue source. Strategic partnerships are vital to increase Booshoot's profitability over the next 5 years, especially as the U.S continues to recover from the recession. IBISWorld states, "Major players are once again expected to rise above the rest in the market, raising the average price of their products through aggressive advertising and brand promotions, and through an introduction of more value added, higher quality products."<sup>108</sup> Bamboo can be a reason for a higher price point. Working with more sustainable resources means companies can market their sanitary paper goods as sustainable.

A very important trend in this industry is that as the birthrate in the U.S and globally increases so the does the profitability of the sanitary paper market. The U.S is a leader in disposable diapers and other baby products. IBISWorld states, "The birthrate in the U.S. has been positive since 2002, growing at an annualized rate of 1.4% over the five years to 2010."<sup>109</sup> A positive growth rate may be hard on the U.S in other ways, but for the sanitary paper industry and Booshoot Gardens the more children the better.

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<sup>105</sup> 2. Lekovic, Sonja. "Sanitary Paper Product Manufacturing." *IBISWorld Industry Report*. No. 32229a (February 2010). <http://www.ibisworld.com.libproxy.uoregon.edu/industryus/default.aspx?indid=425>

<sup>106</sup> Lekovic, Sonja. "Sanitary Paper Product Manufacturing," 7.

<sup>107</sup> Lekovic, Sonja. "Sanitary Paper Product Manufacturing," 4.

<sup>108</sup> Lekovic, Sonja. "Sanitary Paper Product Manufacturing," 7.

<sup>109</sup> Lekovic, Sonja. "Sanitary Paper Product Manufacturing," 7.



Lastly, this is a study on the U.S market, but the international market is a growing player in sanitary paper industry.<sup>110</sup> As the world develops the demand for sanitary paper products will grow and solidify this industry on the global stage for decades to come.

### Threats

Changes in the U.S buying practices has affected this industry, IBISWorld states, "Wholesalers' share of sanitary paper product manufacturer sales is expected to have fallen over the five years to 2010, decreasing from 60% in 2005 to 57% in 2010. This trend is expected due to a rise in the popularity of large retail store chains, and their purchasing power to buy directly from manufacturers, bypassing wholesalers. Online trading and ordering has also made it easier for producers to deal directly with customers."<sup>111</sup> It is interesting to consider that sanitary paper wholesalers will be struggling, but Booshoot would not struggle in this case because the overall demand would not change.

As international competitors provide less expensive products the global industry is expected to grow. IBISWorld states, "The Sanitary Paper Product Manufacturing industry is expected to continue to lose share of the domestic market to imported products. However, profitability is likely to begin to benefit from greater efficiency over the past last few years, brought on by substantial restructuring initiatives by major players."<sup>112</sup> Innovation and niche markets are restructuring techniques of the major players in this industry. Non-wood fibers like bamboo can also be sustainable raw materials that are marketed as green sanitary paper products which are growing in popularity by end users.

### Implications

Booshoot Gardens should first seek out partners in this industry because the sanitary paper industry has the greatest potential for growth.

- The United States is the largest consumer of sanitary paper products in the world and the demand from end users in this industry affects the quantity of products produced. Booshoot should take advantage of the U.S consumer driven demand for sanitary products, but also the growing demand for U.S made, sustainable products.
- The sanitary paper industry has the greatest potential for growth. Domestically the birthrate is on the rise increasing the need for sanitary products. Internationally, as the world industrializes the demand for sanitary products grows. Bamboo fiber can be used in many separate products like fluff pulp

<sup>110</sup> Lekovic, Sonja. "Sanitary Paper Product Manufacturing," 5.

<sup>111</sup> Lekovic, Sonja. "Sanitary Paper Product Manufacturing," 17.

<sup>112</sup> Lekovic, Sonja. "Sanitary Paper Product Manufacturing," 4.

(cotton like pulp), paper packaging, outside liners for pads and diapers, etc. Although this industry is a very small section of the larger paper and pulp industry finding partners in sanitary paper should be a top priority because of the opportunity for expansion and growth.

- Booshoot needs to work with a research lab to make sure the bamboo tissue it processes can be turned into fluff pulp and pulp for paper. This will ensure the best chance of providing a product for the sanitary paper industry.
- Booshoot can sell directly to a sanitary paper manufacturer if the company has a great deal of vertical integration. This will be described in detail in future sections.

### **Paper and Pulp Industry in Review**

All three of these industries have potential for growth and the innovative history to adopt bamboo as a fiber source. Pulp manufacturers will not attempt to make pulp from bamboo without a paper mill to sell the new pulp to. Paper mills in the U.S are the largest of the three industries, but international competitors are changing the industry quickly. The sanitary paper industry is positioned best for growth, but it is considered a small industry because it brings in \$4.6 billion in revenue compared to the larger paper mill industry that brings in \$32.7 billion in revenue .

I recommend that Booshoot start small. The minimum Booshoot can start with is enough bamboo chips to supply one small manufacturing line in a large factory, or enough fiber to produce about 170,000 tons of pulp per year. This scale is similar to the Longview Fibre example, which processed approximately 374,000 tons of chips per year. Working with a paper or pulp mill that has multiple lines will give the company the option of converting one line to bamboo chips. If that line succeeds as expected, Booshoot can consider expanding to supply for more manufacturing lines. However, Professor Lewis from the University of Washington believes that Booshoot should supply to an entire pulping mill 4400 tons of bamboo chips per day or 1,147,142 tons per year. There is a wide range of opportunities for Booshoot and the scale will depend heavily on the demand from manufacturers.

Booshoot Gardens should take advantage of the size and vertical integration in the paper mill industry. It should work with the sanitary paper industry to increase its chance of finding a partner with potential for growth. Lastly, if Booshoot is going to sell to any part of a non-integrated system it will have to work heavily with the pulp manufacturing industry, which poses a challenge because of how few companies make pulp compared to the other industries.

The best chance Booshoot has is to work with highly integrated firms that are looking to improve their environmentally conscious image. A company that is interested in cultivating its own material and has the capital to take a risk with a non-wood fiber would be the ideal company for Booshoot to partner with.

Still to come are important decisions like choosing the right bamboo and the right partners who are willing to manufacture pulp from non-wood fibers. There are cost concerns from manufacturers that they will have to retrofit their machines and processes. There are marketing questions to be answered and partners to consider. At this time industry conditions show that there is potential for non-wood fibers in the paper and pulp industry, but the decisions to come will define Booshoot's success.

## Recommendations

Given the history of the paper industry, the complex supply chain, the importance of downstream demand, the current market conditions and the strengths and weaknesses of Booshoot Gardens, I recommend the following strategies:

- 1) Booshoot Gardens needs to find the cash flow to lease land in the southeast region of the United States, cultivate full-grown bamboo, and sell chipped bamboo to pulp manufacturers and fully integrated paper manufacturing companies. Booshoot should refrain from selling bamboo starts to commercial farmers. This would not bring in enough revenue to offset the resources needed to expand the business to the southeast. A study will need to be commissioned in order to know the exact costs associated with leasing land in the south. It is clear that the south is the cheapest region to lease land in the U.S at this time.<sup>113</sup>
- 2) Booshoot Gardens needs to work directly with large paper manufacturers, which are companies with more than one manufacturing line that typically bring in over \$1 billion annually in revenue with thousands of employees. There is no reason to invest in growing commercial amounts of bamboo without a committed guaranteed purchaser agreement. It would be ideal to find a pulp buyer in the sanitary paper industry because it has the greatest potential for growth. Although, this early in the game no potential buyer should be turned away.
- 3) Booshoot should stay away from smaller partners, companies bringing revenue less than \$1 million annually. The high barriers to entry and competitive nature of the paper industry means in order to create long-term fruitful relationships Booshoot should be focused on partnering with leaders in the industry.
- 4) The sanitary paper industry is a smaller industry, but it has the greatest potential for growth. Booshoot should be working with sanitary paper manufacturers to secure its position in the paper industry with the fastest growing market. Booshoot should simultaneously stay away from the newsprint industry as it is declining at the fastest rate in the industry and advances in technology are diminishing the demand for newspapers.
- 5) Booshoot needs to maximize cost-cutting measures when cultivating bamboo. Cost cutting measures include: fewer pesticides, no replanting, fewer regulations than the timber industry, and possibly lower transportation costs because the bamboo can be grown on site. If bamboo chips are cheaper it will be exponentially easier to sell bamboo chips to manufactures that are solely using wood chips.

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<sup>113</sup> Mark Lewis.

- 6) Booshoot needs to find a company that places resources in the marketing of its paper. Downstream demand drives the early stages of the supply chain. Bamboo will only succeed in the paper industry if the points of differentiation are made clear. Bamboo uses fewer pesticides and less water therefore the paper can be marketed as an environmentally sustainable product.
- 7) Using bamboo in paper production would also allow the paper industry to become less dependent on the volatile timber industry. As the restrictions on the timber industry grow the price of wood chips goes up. Moving away from the timber industry is a long-term conversation, but a paper company that can find many sources of raw material will be more resilient to changing market conditions. Booshoot should use this as a selling point when seeking buyers for its product.
- 8) Lastly, before entering the paper industry, Booshoot needs to define its expectations for the environmental practices of its partners. When working with large players in the paper industry a portion of many businesses may be sustainable, but it will be hard to find a large paper company that has an entirely green business model. Booshoot needs to decide if it is going to shrink or expand its potential list of partners based on their environmental standards.

### **Ideal Partners in the Industry**

Based on the recommendations above and the projected industry conditions here are companies that would be ideal for Booshoot Gardens to partner with. Below is a chart which details the leaders in the sanitary paper industry. This industry has the greatest potential for growth and should be Booshoot's first target for potential partnerships. These companies are also highly integrated and have pulping mills located in southeastern region of the United States.

I have also indicated whether or not the company has international segments because the paper industry is expanding rapidly. Booshoot Gardens should especially seek out companies that meet partnership priorities in the U.S and have an international arm.<sup>114</sup>

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<sup>114</sup> Lockwood-Post. "Directory of Pulp and Paper Mills." North American Editorial Office. 2008.

| Company Name                   | % Control of the Sanitary Paper Industry | Pulp Mill Location | Integrated   | International Arm |
|--------------------------------|--|--------------------|--|-------------------|
| Kimberly-Clark Corporation     | 39.9%                                    | AL                 | Yes- Pulping, Manufacturing<br><br>Brands: Cottenelle, Depends, Huggies, Scott Towels, Kleenex, etc. | Yes               |
| Koch Industries, Inc.          | 27.5%                                    | N/A                | Yes-Manufacturing<br><br>Brands: INVISTA, Lycra Fiber, COOLMAX Fiber, Stainmaster Carpet             | No                |
| The Procter and Gamble Company | 21.3%                                    | MO, GA             | Yes-Pulping, Manufacturing<br><br>Brands: Bounty, Swiffer, Pampers, Charmin, Tampax                  | Yes               |
| Johnson and Johnson            | 3.3%                                     | N/A                | Yes-Manufacturing<br><br>Brands: Stayfree pads, Carefree pads, Band-Aids                             | Yes               |
| Energizer Holdings, Inc.       | 2.2%                                     | N/A                | Yes- Manufacturing<br><br>Brands: Playtex  | Yes               |

Below are the next priority partnerships for Booshoot, U.S pulp mills. The simplest point of sale for Booshoot Gardens will be selling bamboo chips to a pulp mill.<sup>115</sup>

| <b>Company Name</b>         | <b>% Control of the Pulp Mill Industry</b> | <b>Pulp Mill Location</b> | <b>Pulping and Manufacturing</b> | <b>International Arm</b> |
|-----------------------------|--|---------------------------|----------------------------------|--------------------------|
| Domtar Corporation          | 11.5%                                      | AR                        | Yes- Pulp and Manufacturing      | Yes                      |
| International Paper Company | 13.5%                                      | AL                        | Yes- Pulp and Manufacturing      | Yes                      |
| Weyerhaeuser Company        | 16.7%                                      | AL                        | Yes- Pulp and Manufacturing      | Yes                      |
| AbitibiBowater Inc.         | 6.4%                                       | AL                        | Yes- Pulp and Manufacturing      | Yes                      |
| Georgia-Pacific             | 3.8%                                       | AL                        | Yes- Pulp and Manufacturing      | Yes                      |

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<sup>115</sup> Lockwood-Post.



### Next Steps

Based on the aforementioned research I recommend the following next steps for Booshoot Gardens:

- 1) Commission a research study from the University of Washington to find the ideal bamboo for the paper industry. The University of Washington is the closest program to Booshoot Gardens and none of the other top paper engineering programs in the U.S are located in the southeast. This study should also take into account the climate conditions in the southeast.
- 2) Pursue partnerships with pulp mills and integrated paper manufacturers to find buyers willing to make and market bamboo paper.
- 3) Find investment bankers in the southeast who are willing to invest the capital needed during the three years it takes bamboo to grow to maturity. Booshoot will need to research the costs associated with the southeastern region of the United States. At this time the southeastern region is the cheapest place to lease land for agriculture in the U.S.<sup>116</sup>
- 4) Develop a low cost method to grow and chip bamboo in the southeastern region of the United States.
- 5) Commission a thorough financial analysis that will help Booshoot decide the best price point for chipped bamboo in order to maximize profits and encourage future partners. This study should also take into account the costs associated with leasing land, growing bamboo to maturity, and chipping bamboo for sale. A financial analysis is the next step after this feasibility study has detailed places in the paper industry where Booshoot can succeed.

With these recommendations and action steps, Booshoot can succeed in the paper and pulp industry as a raw material supplier. The decision to enter the paper industry should not be taken lightly and Booshoot needs to be willing to negotiate with industry leaders and commit fully to this type of capacity building.

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<sup>116</sup> Mark Lewis.

## Conclusion

This is a very exciting time for Booshoot Gardens. The global market for bamboo exceeds \$10 billion per year. By 2018 the global market for bamboo is expected to reach \$20 billion. The United States is the #1 importer of bamboo in the world and it is time the U.S. invests in commercial cultivation of bamboo.<sup>117</sup> There is great potential in the paper and pulp industry for Booshoot to set the stage and change the direction of a very powerful international industry. It is time that the paper industry moves away from reliance on the timber industry. It is time the paper industry takes real steps towards environmental conservation and a reduction of its carbon footprint. Booshoot and paper made from bamboo can be the change the paper industry needs.

Booshoot should go after this industry with full force and seek out partnerships with leaders in their individual market segments. The vertical integration in this industry gives Booshoot the opportunity to work with strong corporations like the International Paper Company and the Kimberly-Clark Corporation.

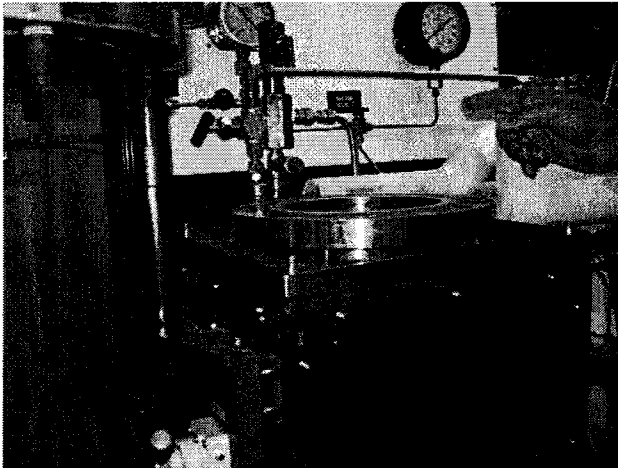
It will take a great deal of company resources and time, but Booshoot Garden's move into the paper and pulp industry will greatly benefit the company's bottom-line and most importantly benefit environmental sustainability around the world.

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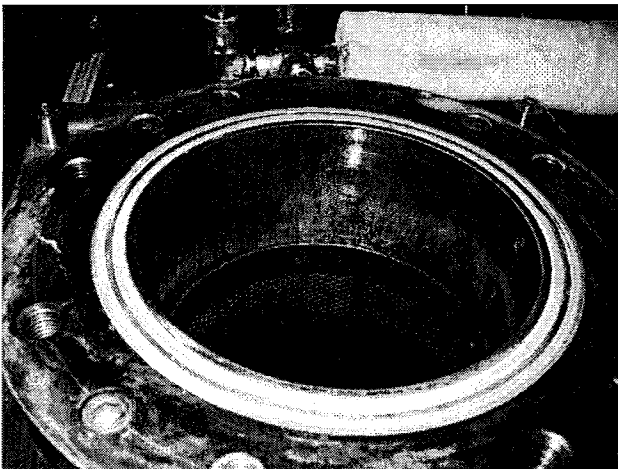
<sup>117</sup> Bamboo Now.

### Appendix A- University of Washington Non-Wood Fiber Lab

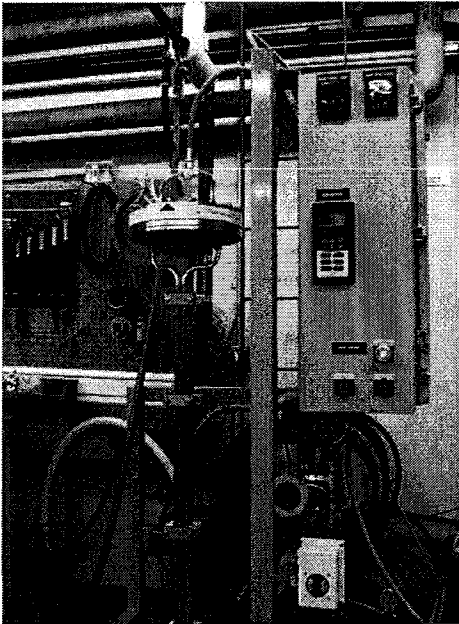
The University of Washington can go from chip to a sheet of paper in one facility. The UW is the only university in the country that has the full spectrum of paper making and a separate lab that focuses on non-wood fibers. An interview with the head of the department Professor Mark Lewis allowed me to see the paper manufacturing process in its entirety. This research helped me build recommendations for Booshoot Gardens with a clear vision of where bamboo fits into the paper manufacturing process. See the process below for details.



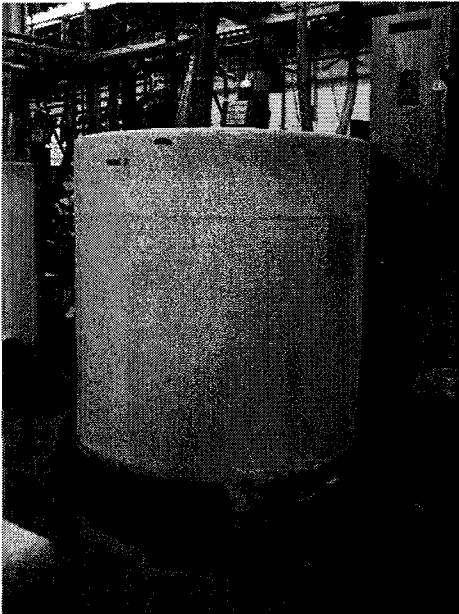
Digester



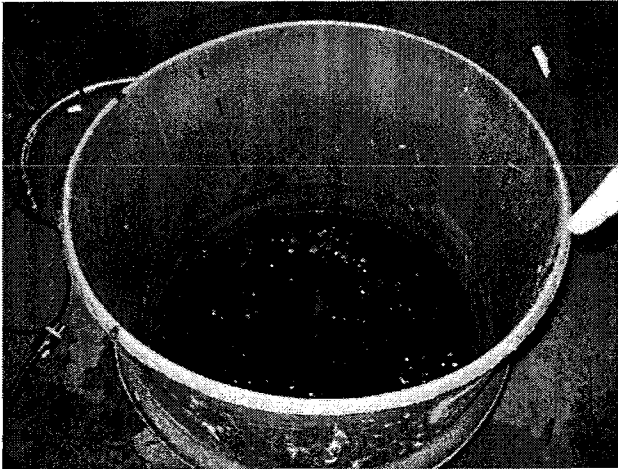
Digester- showing chemical holes where the chemicals come out of and the strainer that hold the chips and eventually gives fibers



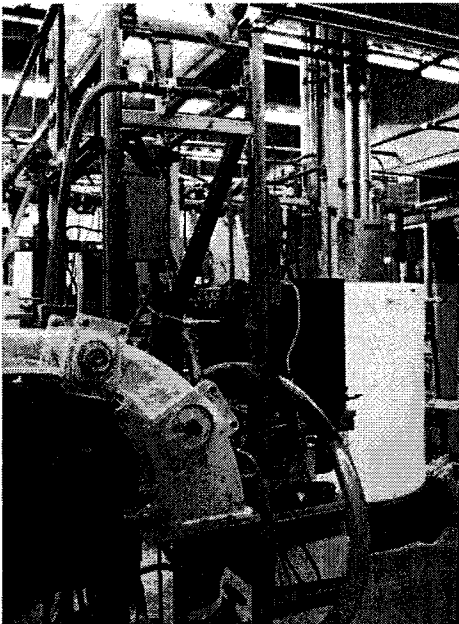
Membrane separator: gives hemi-cellulous and lignin which is called Black Liquor. Hemi-cellulous gives simple sugars that can be turned into glycol which are the building blocks to many plastics



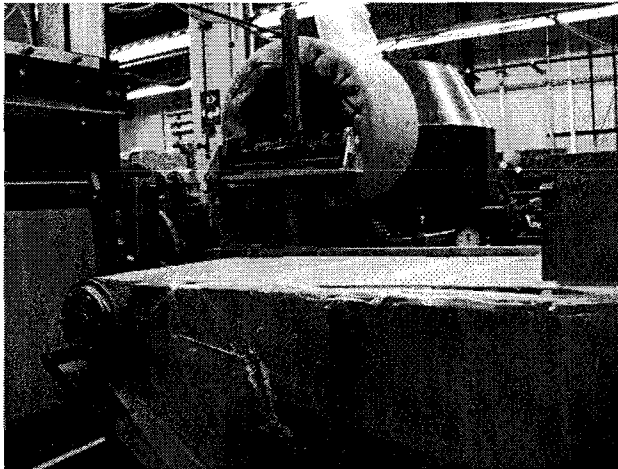
Chips and pulp container



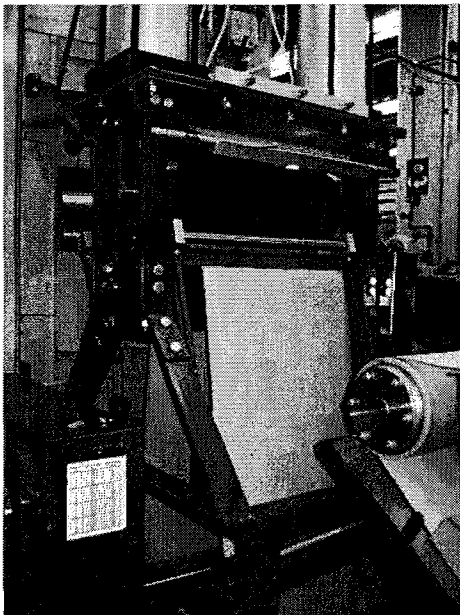
Black liquor: a by-product 80% lignin and 20% hemi-cellulous. The white spots are mold from the sugars. Each year the US uses billions of barrels of oil to make plastics we can be doing that same work with etholyn-glycol which can be made from black liquor.



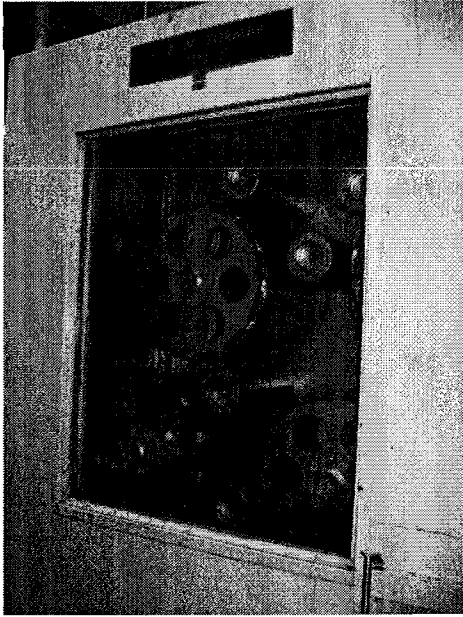
Large picture of processing. Chips and chemicals go in the large barrel and make pulp called the wet start



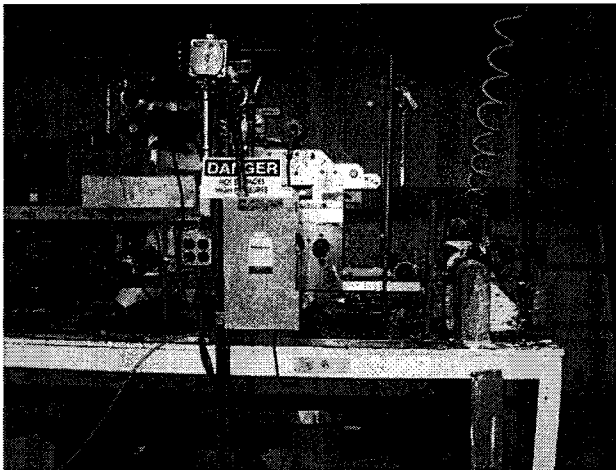
On the wire: called the head box phase 99% water here



Press stage: 60% water 40% fiber



Drying stage



Coder: use latex as a binder and pigment to color, resulting in a wide variety of paper

The University of Washington has the entire paper process in one lab, but it is important to clarify that commercial paper manufacturing the machines are much larger. See photos below.

This image has been redacted, pending copyright permission.

This image has been redacted, pending copyright permission.

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<sup>118</sup> Tu Delft. Delft Center for Systems and Controls.

[http://www.dsc.tudelft.nl/~xbombois/project\\_rb\\_pvdh\\_xb.html](http://www.dsc.tudelft.nl/~xbombois/project_rb_pvdh_xb.html)

<sup>119</sup> Celsias. Paper Manufacturing Facilities. <http://www.celsias.com/article/international-paper-growing-genetically-engineered/>.



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