

## Case studies in the lowest cost resolution of uncertainty

The four examples provided here are intended to illustrate the approach described in “Knowing what unknowns to know in entrepreneurship.”

### Align Technology

Align Technology was a company founded in 1997 in Santa Clara, CA and initially funded by Kleiner Perkins.<sup>1</sup> The company was created to develop a new device for correcting malocclusion (crooked teeth). The product, Invisalign, was introduced in 1999. The product concept was a series of custom-made, clear plastic retainers that would have the ability to move teeth. The premise for the company was that the application of computer modeling and custom manufacturing technologies could turn this concept into a scalable and profitable enterprise. Over the first six years of its existence, Align burned through \$270 million of capital raised from venture capitalists and through an IPO and almost came to an ignominious end before new leadership righted the ship. Almost out of cash and with its stock price at one tenth of the IPO price, the company turned the corner and became cash flow positive. One could argue that, had the company not had the good fortune of a truly compelling value proposition and a product that was significantly superior to the conventional approach in every relevant respect, the company would have ceased to exist. Now, Align is growing rapidly with 2015 revenue projected to be greater than three quarters of a billion dollars and has become the dominant supplier to the orthodontic market. Was the near death experience necessary?

In its early years, Align pursued the conventional strategy of driving for very high growth. In addition, the company recognized that mass customization capabilities would be a source of long-term competitive advantage. Therefore, the company invested heavily in developing and implementing the necessary technology internally rather than developing partnerships to manufacture its product. Finally, the company’s original strategy was to target the consumer as its customer, assuming that a motivated consumer would request and receive orthodontic treatment based on Align’s Invisalign system from a certified orthodontist. The net result of these three strategic decisions was a very high and ineffective cash burn.

In keeping with the premise that it could create an automated, technology driven manufacturing platform that could deliver the Invisalign product at a fraction of the market’s willingness to pay, the company projected 60—70% gross margins as the technology matured. This goal has, in fact been achieved, but it took many generations of technology and much trial and error. While the company was

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<sup>1</sup> The observations and analysis offered here are from the author’s personal experience with the company, but the interested reader can get a perspective on the company and its challenges from Bowen and Groberg 2002.

working to establish a stable, cost effective manufacturing platform, it was also driving for high growth, with negative gross margins and costly quality issues. Exacerbating the company's problems was a single-minded focus on marketing programs targeting the consumer despite signs that these programs were much less effective than anticipated. This focus resulted in large and relatively ineffective marketing expenditures and an investment in capacity that was significantly misaligned with the demand generated.

Was all this necessary? A more rational approach to building this company would have been to identify and decouple the assumptions that were the basic premises of the company. Put differently, we can think of the original venture as a theory comprising a number of different assumptions. Some of these assumptions involve customers and what they will value, some involve technology and other aspects of production, and some are about the long-term competitive position of the company. An analysis might have suggested testing the market first, validating the assumptions about willingness to adopt among both constituencies served — consumers and orthodontists. The relevant assumptions could have been tested in a few regional markets. Once the basic market need had been established, the company could have tested hypotheses about size of the market, obstacles to adoption, pace of adoption, and, critically, the effectiveness of various approaches to demand creation. On the last point, the company would have discovered early on that it was not patient demand, but rather a combination of patients' awareness and orthodontists' acceptance that was required to drive demand. Of course, testing the market would have involved creating a manufacturing system capable of producing the Invisalign product, but this could have been on a smaller and more controlled scale than the company's actual operations. Such a production facility would have allowed the company to test some aspects of the process that involved interaction with the orthodontist. However, most elements of the system could have been developed and optimized independently of the production system instead of what actually occurred which was that relatively small advances were put into production and scaled up only to be replaced at great expense by the next relatively small advance. It is worth noting that the Align manufacturing system is very complex, consisting of six discrete and very different process steps (such as 3D scanning, stereolithography, etc.) and a very complex data management and control system. These could easily have been decoupled and optimized separately. (Finally, the company would have made its investments in intellectual property protection in parallel but these were naturally separate from the other activities of the firm.) Such an approach probably could have created the same company possibly for half the capital and without the trauma of a near death experience.

## **Rent the Runway**

A very different example is Rent the Runway.<sup>2</sup> Rent the Runway has been a terrific success, and has built a base of more than five million clients since its launch in 2009. Contrary to mythology surrounding entrepreneurship, the two founders, Hyman and Fleiss, pursued a very methodical and controlled approach to building their business. The success of their business model rested on the dual pillars of consumer behavior and partnership with designers. They identified the key assumptions in both areas, and tested and revised those assumptions as appropriate. Not until they had built a solid foundation of validated assumptions in these two critical areas did they launch the service. On the side of consumer behavior, they began with the simple thesis that young women would rent dresses. They conducted two market trials at Harvard, which satisfied them that there was a significant willingness to rent. The next step was to determine whether women would rent dresses without trying them on. In a trial at Yale, they found that 75% of the participants rented. Next, they proceeded to the critical thesis that women would be willing to rent dresses on a website. They conducted a trial with a random sample of one thousand women who had expressed interest. However, rather than building a website for the trial, they simply emailed pictures of the dresses as PDFs. Once again, their thesis was validated. Similarly with the designers, they proceeded in a systematic, open-minded way. Here again, they arrived at a conclusion that was satisfactory but this process involved more learning and revision. The discipline that these founders employed rather intuitively involved identifying discrete assumptions and then testing them as economically as possible and in a logical order. If there were any adverse outcomes of these tests, they made revisions and tested again. In contrast to Align Technology, Rent the Runway illustrates the lowest cost resolution of uncertainty.

## **CrowdTunes**

We will take a more detailed look at two simpler examples, both recent graduates from the entrepreneurship program at Duke University. One would be classified as a tech start-up and the other is based on university research in biology. CrowdTunes, the tech company, has a familiar structure — it is a smart-phone app with a server backend. The initial idea was to replace the jukebox with a social experience — allow bar patrons to bid for their chosen music. As with many such businesses, the impetus was the young founders' own experience. The idea seemed appealing to them so they extrapolated that the idea might appeal to people like them. Moreover, if it was appealing to bar patrons, it would probably be attractive to bar owners. How should they proceed? We begin by identifying the important unknowns.

1. Will the activity itself resonate with the intended audience enough that it might become a regular part of going out to bars (i.e., is the need real)?
2. Will bar owners find it an attractive complement to their business or a nuisance?

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<sup>2</sup> See Eisenmann and Winig 2012.

3. Can rights to play music be secured economically?
4. Is there enough of a market to be interesting (number of patrons participating and amount of money bid)?
5. Can customers be acquired economically?
6. If they demonstrate an interesting business opportunity, will an established player simply take it away?

Notice that there is nothing on the initial list about technical feasibility. It may be that there is some issue lurking in the technical details; but this is highly unlikely. The system that needs to be developed involves pieces that are sufficiently well understood that the question of technical feasibility should not be on the initial list. Moreover, the investment required to build such a system can be well enough bounded that not even this question needs to be considered at the outset. Recognize that focusing on these questions does not require a fully functioning company. Recognize further that a positive answer to all of these questions would provide a dramatic step up in our confidence that the venture can succeed, and indeed may give us the confidence to start building out the company.

Question 1 is the foundation for the venture. However, the bar owners are the gatekeepers. If they are not interested, then it will be difficult to get very far. So one reasonable path for these entrepreneurs could be as follows. First, explore the needs and interests of bar owners with the goal of finding a way in so that they can test their idea with bar patrons (question 2). The founders took this step and discovered sufficient interest to proceed. They also discovered that managing music is actually a pain point for bar owners, which constitutes an additional opportunity. The next step was to create a prototype to use as a test vehicle (question 1). Because of the assumption that there are no issues with technical feasibility, a simple system with the minimum necessary function would be sufficient. They could assume that they did not have to worry about the architecture of the system since they could plan to throw the entire prototype away. They managed to find a bright undergraduate engineering student who was able to build a prototype (iPhone only). They tested the idea in a few evenings in a few bars. Initial results were encouraging.

Now things become more complicated. They were able to establish the initial appeal of bidding for songs, but what kind of market did this really represent (question 4)? Would the novelty wear off and usage dwindle? Would this only be interesting on Friday and Saturday nights, or were other days also revenue potential? Are there other sources of revenue open to them? The testing now needs to be more sophisticated. On the positive side, they have discovered that relieving the bars of the music management problem is valuable enough that they may be able to get bars to pay them, instead of having to share revenue with the bars which was their original assumption. They have also discovered additional revenue potential. On the other hand, revenue from bidding activity has been unpredictable. So they are making adjustments in product and other areas to find the right formula.

After some initial traction is gained, the question of obtaining legal rights becomes more relevant (question 3). Although the team had done a very cursory investigation early on, it became time to investigate more seriously. It was time to invest in reliable legal work to determine what the terms of a license would be for this venture. With more confidence in the revenue model, the team needed to execute those agreements. Similarly, the question of customer acquisition costs (question 5) had been on the table since the outset, but no serious work was done until they had some level of validation of the idea. After validating the idea, the team needed to spend significant effort exploring and testing a variety of distribution alternatives.

Finally, the question of competitive threat (question 6) lies in the background. Why won't a company already in the music distribution business simply add a feature that crushes CrowdTunes' chances? This question remains unanswered, but the answer will lie in their ability to create value and a compelling experience for both patrons and employees (primarily bartenders), and to do it in a way that is difficult to imitate. To the extent that CrowdTunes can create a system that is not easy to copy, in its elements or combinations, it will make itself more viable as a standalone entity or an acquisition. To the extent that its solution is obvious, it probably will not have a future.

### **Grassroots Bio**

GrassRoots Biotechnology is a company formed to commercialize the research of a prominent scientist in the area of systems biology. He has spent a large part of his career researching the problem of controlling characteristics of plants. More specifically, he studied the complex subject of how genes and gene expression are related to characteristics of interest. He developed a platform for modifying these factors. In the course of this work, it occurred to him that there might be a commercial opportunity here, or even a company. Analysis by a small team of business students concluded that there was indeed an opportunity worth pursuing, there is indeed a sizable market for "better" plants.

He and one of Duke's graduating MBA students formed a company. They could either plan to become an agricultural biotechnology company ("ag bio") or sell to ag bio companies. They formed a company in an environment where investment would be difficult to secure, but advancing the technology required considerable capital. They concluded that their most likely path to success was to consider ag bio companies to be their customers rather than competitors, and to try to get funding from one or more of them to develop products.

Prior to founding the company, there was a preliminary validation of a market opportunity — people would pay for superior crops — and a technology platform that was on its way to being protected intellectual property. When the two founders formed the company, they had technology (assuming successful negotiation of a license agreement with the university) and the reputation and knowledge of the scientific founder. At this point, they had not identified a specific market need,

so the question of technical feasibility was still moot. The two founders began to explore. Three dimensions were important: which ag bio company would be a good partner, which crop should they target, and what characteristics of the plant (e.g., more efficient uptake of nitrogen or drought tolerance) should be modified? Early on, they narrowed their search to four potential partners, four crops (corn, soy, cotton, canola), and four characteristics. Moreover, they had to go down a path where they had confidence in being able to deliver a solution, because they probably could not survive if they failed to deliver on a contract. Through a series of conversations and negotiations with some of the potential partners, they were able to hit on a need that they thought they could satisfy with one of the potential partners. They signed a multiyear development contract, and built out a technical capability and a scientific team. They were able to deliver on their commitments (not without difficulty) and at the same time create additional intellectual property and value in the company. In the end, their partner acquired the company for an attractive sum, and absorbed all the employees except the two founders.

With CrowdTunes and GrassRoots, we have two quite different stories. CrowdTunes began with a very specific market hypothesis, whereas GrassRoots began with a high level need for better plants. CrowdTunes envisioned a market with many customers, GrassRoots a market with very few customers. GrassRoots had a technology platform that could have many applications. Technical feasibility and intellectual property protection were important issues. For CrowdTunes, technology was not an issue, at least in the early stages. The capital requirements for CrowdTunes to get customers and revenue were small, and there are many investors who would be willing to put money in if the concept were validated. On the other hand, the capital required to develop the GrassRoots technology was significant and only strategic partners would be willing to invest to develop the technology.

## References

- Bowen, H. K. & Groberg, J. P. 2002. Align Technology Inc.: Matching Capacity to Sales Demand. Harvard Business School. Case #603058.
- Eisenmann, T. R. & Winig, L. 2012. Rent the Runway. Harvard Business School. Case #812077.