

UNIVERSITY OF TARTU VILJANDI CULTURE ACADEMY

Design and Development of Virtual Environments

Ivar Laks

Himshwet Gaurav

**CHALLENGES OF IMPLEMENTING CUSTOMER DISCOVERY IN
LEARNING ANALYTICS: A CASE STUDY OF ALGOLE**

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Supervisor: Marge Sults, MSc

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EXECUTIVE SUMMARY

There is a strong mismatch between demand and supply in current state of higher education in India. Over a million students aspire for a seat in the coveted top tier universities offering around 15 000 places. The students have to undergo a series of entrance examinations and based on their performance top candidates are offered a place. This gap between demand and supply has given birth to a highly competitive environment where students reach out to professional coaching institutions to improve their chances of success in the entrance examinations. The teaching methods of the coaching institutions do not consider the characteristics of different students and do not provide guidance based on the students actual needs. Algole, a learning analytics startup, is building a system to optimize students test taking strategy and help them achieve a higher score in the entrance examination. To validate the problem and solution the Algole's team used the knowledge of Eric Ries' Lean startup and Steve Blank's customer development methodology.

This aim of this thesis is to discover the specific challenges of implementing customer discovery methodology, the first of customer development, in the field of learning analytics. The thesis further concentrates on Algole with an aim to discover flaws in their conducted customer discovery process and provide critique and recommendations for validating their business model hypothesis. To conduct this research authors had access to all the data Algole's team had gathered during their customer discovery process and held several interviews with the team members. Based on this information a detailed account is given about the chosen methods used by Algole and by analysing gathered data the authors of this thesis derive to the following conclusions. The main challenges for implementing the customer discovery methodology in the field of learning analytics are difficulty in measuring the impact of the service, the burden of educating the customers about the new product, sourcing reliable data for validating the product and engaging with multiple entities in the customer segment. Also the authors conclude that Algole made several mistakes in the customer discovery process and their main hypothesis still needs testing. To further validate the problem and solution the team needs to improve the design and the implementation of the minimum viable product experiments, define clear metrics and focus for the experiments, further validate the pricing, study the field of educational assessment to gain new knowledge that could be used for the hypothesis validation and improve teamwork and commitment to the project.

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1 INTRODUCTION

1.1 Context

There is a great disparity between the demand and supply for good quality tertiary education in India. India has the second largest population in the world, next only to China. In 2013 the population based on World Bank's statistics was 1.25 billion (Population of India). As per the census the share of population in age group 0-14 constitutes 30% and in the age group 0-25 constitutes over 50%. One can infer from this that approximately 15% of the population is either enrolled or will be enrolling for a tertiary education.

After economic liberalization in 1991, there has been a huge inflow of investment in the public as well as private education sector however the quality of education offered by a majority of these institutes is still not upto the mark. In the Times Higher Education annual survey for the year 2014 only five Indian universities made it to the top 400 list. (World University Ranking 2014-2015, 2014) The survey is not an authoritative benchmark but reflects on the current state of tertiary education in India.

For aspiring candidates this situation leaves them with limited option. In the field of engineering the top ranked institutes like Indian Institute of Technology (IIT) and National Institutes of technology (NIT) are all publicly funded and offer limited seats each year. Apart from providing quality education these institutes demand affordable tuition fees in comparison to their private counterparts. IITs which were established after India gained its independence has now built a strong and accomplished alumni network which makes it the preferred choice for Indian and multinational corporations in India. All these factors have led to making these institutes the most lucrative option for a candidate finishing their secondary education.

Being publicly funded institutes, the admissions are based on a merit list prepared based on the performance of the candidates in an all India entrance examination and they are given an all India rank (AIR). These examinations are held once every year in two stages and consist of multiple choice based questions in three subjects - physics, chemistry and mathematics. The syllabi for the exam comprises of the curricula in these three subjects as prescribed in the last two years of secondary education. There is however a difference in the level of difficulty and the kind of

questions which are presented to the candidates in this exam compared to what they are taught in their regular syllabi at schools during their secondary education.

Due to the difficulty of the exams various private institutions came into existence in the late 90's which offer additional training to the students. They offer a streamlined programme where students are taught the curricula similar to that of schools but in more detailed level. The programme is focused on imparting the students skills to solve questions presented in the entrance exams. During their preparation the students attend classes at the coaching institutions, they are provided with supplementary reading material which mainly comprises of compendiums of sample problems and appear regularly for mock tests. Majority of these candidates spend from six months to three years preparing with the coaching institutions for the entrance examinations.

Till the turn of the century, the competition though strong was not so intense. In the year 2002, 150 000 candidates appeared for 3000 places in seven IITs. With a boom in the information technology sector and changes in the educational policy by the government these numbers rose to 1 million candidates appearing for 15 000 places in IITs and NITs in the year of 2014. (Report of a Joint Implementation Committee 2014) Till early 2000's the second level of the exam was essay type but now with increased amount of applicants it is no longer feasible to grade essay type

Rank	Total marks	Rank	Total marks	Rank	Total marks	Rank	Total marks
1	334	1001	227	2001	206	3001	193
101	278	1101	225	2101	204	3101	192
201	267	1201	222	2201	203	3201	191
301	259	1301	220	2301	201	3301	190
401	252	1401	218	2401	200	3401	189
501	246	1501	216	2501	199	3501	188
601	241	1601	213	2601	197	3601	187
701	237	1701	211	2701	196	3701	187
801	234	1801	209	2801	195	3801	186
901	230	1901	207	2901	194	3901	185

Table 1. Students ranking and total marks of the entrance examination taken in 2013 (*Source:* Report of the Joint Implementation Committee for JEE 2014, 14)

questions and the format was changed comprising of multiple choice based questions only. The results of the entrance examination taken in 2013 show that candidates dropped from 200-400 ranks in the merit list for losing three marks on the exam (See Table 1). The drop is even bigger on lower ranks.

The Associated chamber of commerce and Industry of India (ASSOCHAM) in a survey in 2013 titled “Business of private coaching centers in India” pegged the size of private coaching industry in India at about \$23.7 billion and forecasted its size at \$40 billion by 2015. The report further estimated the growth rate of the market at 35% in last five years. The specific market segment which caters to IITs aspirants is pegged at \$400 million. (Private tuitions now a multi-billion rupee industry: Survey 2013) These numbers coupled with the current state of cut throat competition among the aspirants makes up for a strong business case.

The business potential and lack of learning analytics services in the current market gave birth to a new startup venture, Algole (See Figure 1). One of the authors of this thesis along with three other entrepreneurs comprise Algole’s team. Each team member is engaged with the project on a part time basis. Two team members reside in New Delhi, India; one in Kolkata, India and one in

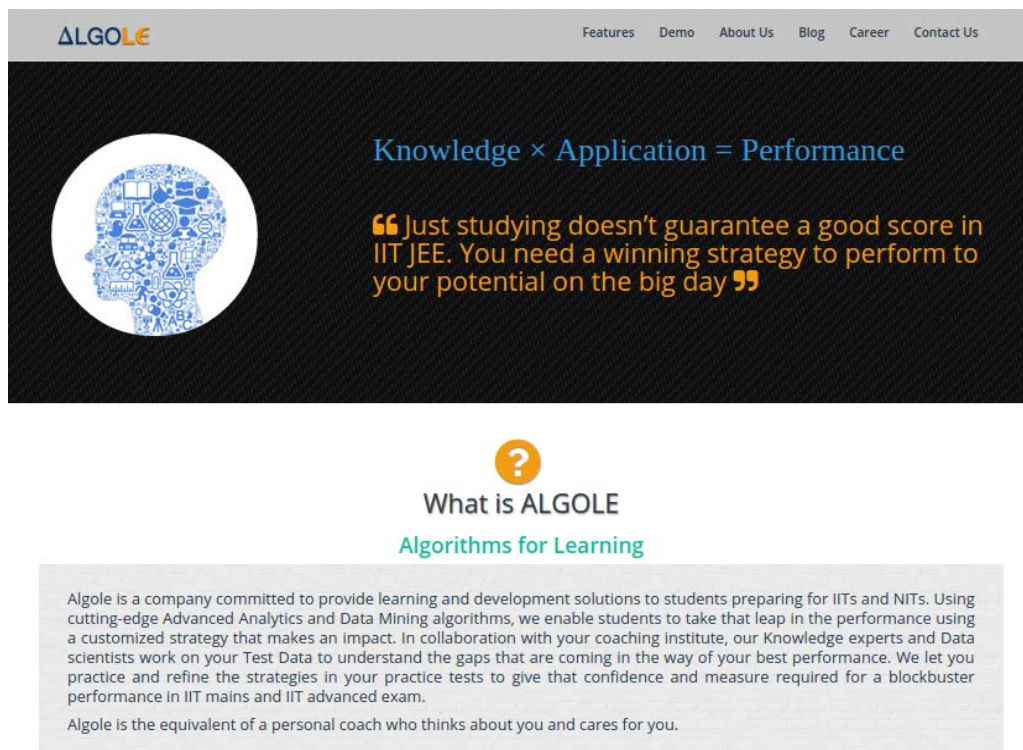


Figure 1. Website of Algole - a learning analytics service (Source: Algole’s homepage)

Tallinn, Estonia. The vision of the startup is to introduce learning analytics in the Indian education coaching industry to raise its quality and efficiency. All its team members have themselves undergone the coaching process and succeeded in the entrance examination for undergraduate courses in engineering. To capitalize on this experience, the engineering discipline was chosen as the entry point into the market. Applying analytics to student's examination behaviour was identified as the niche.

While application of analytics in the field of education to monitor and aid a student's learning process is in itself not a novel idea, but introducing a new paradigm in an existing market is not a trivial task. The established market players always resist new entrants and there are multitude of other variables that come into play. Identifying the most vulnerable part of market that would be eager to accept a new solution, moulding the available technology into a product which indeed solves the problem and is viable in the long run - such tasks require focused and methodical inquiry. Algole adopted Steve Blank's customer development methodology to build its venture.

1.2 Motivation

Lean startup methodology is relatively new. There are several books written on the subject. Some books discuss the concept in terms of principles, others delve deeper into providing practical steps to apply the methodology. In addition there are different software based tools that incorporate the principles of lean startup methodology and assist startups in carrying out customer development.

However the principles and methodology are generic in nature and do not cater to any particular industry segment. The authors are of the opinion that each industry segment presents its own challenges when carrying out the customer development methodology. Design and development of minimum viable products (MVP) are constrained by different factors in different segments. Carrying out experiments to develop a new product for example in the financial sector are constrained by legal frameworks which are irrelevant to a team developing a new messaging application. In light of these arguments the authors' primary aim is to find out if challenges specific to learning analytics can be isolated.

Algole has not achieved the expected success through its customer discovery process. To this end, the secondary aim of the thesis is to give a set of recommendations to Algole's team on how to

improve their customer development and suggest further experiments to be undertaken in order to further validate the problem and solution hypotheses and proceed to the customer validation stage.

Lastly, Algole's project at the moment focuses on students from the engineering discipline - IIT aspirants. There are various other customer segments of students who aspire for a career in the field of medical science, management studies, information-technology etc. If the project succeeds in its current market Algole plans to replicate the services for students from other disciplines as well. The final aim of the thesis is to serve as a reference during the replication process by aiding in experiment design and interpretation of customer research data.

1.3 Research Questions

The research questions of this thesis are based on customer discovery process, first step of customer development. The authors study the customer discovery process undertaken by Algole's team in pursuit of building a business which offers learning analytics services to the Indian coaching industry. In line with the motivation for this thesis the authors seek out the answer to the following research questions:

1. What are the specific challenges in implementing customer discovery methodology in the field of learning analytics?
2. What were flaws in Algole's customer discovery process and how they can improve it?

1.4 Scope and Structure of the Thesis

The lean startup methodology comprises of various iterative steps. The thesis concentrates on customer discovery as Algole is still in its early phase. In the second chapter the authors give an overview of Eric Ries' Lean startup and Steve Blanks' customer discovery methodology. The third chapter, divided into three phases, gives a detailed account of how the Algole team used the customer development methodology. For every phase the authors provide an overview, objective of the phase, research methodology, results and analysis. Each phase ends with conclusions which make up the context of inquiry for the succeeding phase. The last chapter details the final results, authors present their critique on how the customer development methodology was applied and also give recommendations to Algole's team on which steps to take in future to validate the hypothesis needed for starting with customer validation, the second step in the customer development process.

2 LEAN STARTUP METHODOLOGY

2.1 Hypothesis-Driven Approach

Launching an analytics based system for improving students test taking strategy is a very new concept considering that the education coaching industry in India has remained stagnant for the last twenty years. There have been no remarkable innovations or changes on the market. Launching a new product or service like this - whether it is a startup or an existing company - has always carried a very high level of risk. The possibility of failing is very high. This is especially true for solutions based on technology and for the technology sector as a whole where market conditions can change very fast and competition is fierce. According to Harvard Business School lecturer Shikhar Ghosh, 75% of all startups fail (Gage 2012). The outlook for a successful new product launch is also pessimistic: 40 - 90% of new products fail depending on the category (Gourville 2006).

The problem lies within the process how new ventures are being developed. The classic process has a heavy emphasis on planning - gathering information, analysing the information, creating a plan. After planning comes designing, building and finally launching. The main shortcoming of this process is the lack of customer involvement in the planning and building phase. When customer are not involved into the process early on then the decisions are based on intuition, not on actual data and customer feedback. This can lead into building and marketing products before the actual customer need is validated.

The Figure 2. gives an overview of the classic product-centric software development process. It involves some customer involvement during the requirements-gathering phase but leaves most of the customer validation until after the software is released to the users. This means that most of the learning is also happening after the release. There lies the biggest risk - while the team is learning a lot about product development, they stop learning about customers, their actual needs and problems.

It is during this time, that there is a risk to either building too much or building something that the customers do not need at all. While the classic approach might work for an existing company because they already know their market and customer needs, but it does not work for startups. The main distinction is that the existing company executes a validated business model based on years of experience on the market while a startup is looking for one.

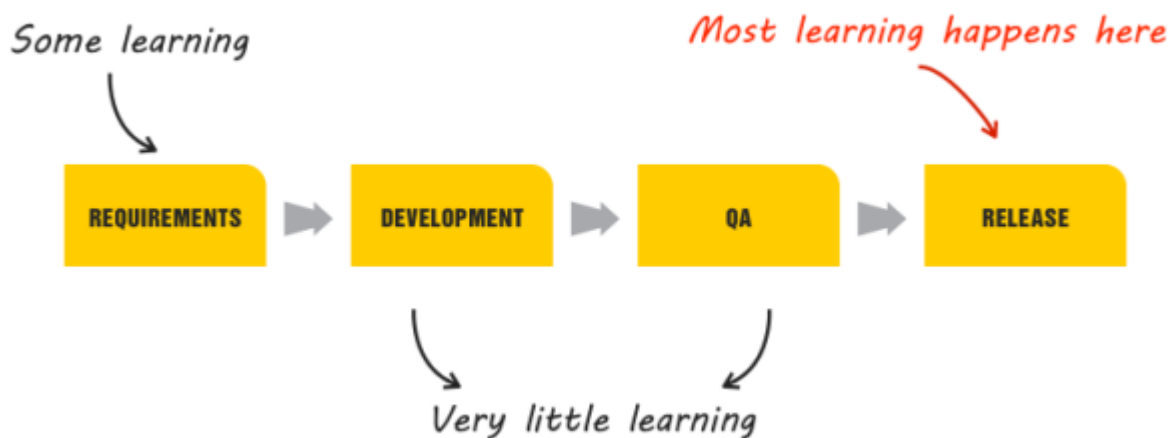


Figure 2. Product-centric development process. (Source: Maurya)

In recent years a hypothesis-driven approach has emerged that helps reduce the biggest risk facing companies: offering a product that no one wants. It is called “Lean startup” methodology, a set of practices popularised by Eric Ries for helping entrepreneurs increase their chances of building a successful startup. According to Ries “The goal of a startup is to figure out the right thing to build - the thing customers want and will pay for - as quickly as possible. In other words, the Lean Startup is a new way of looking at the development of innovative new products that emphasizes fast iteration and customer insight, a huge vision, and great ambition, all at the same time” (2011, 20) Lean Startup methodology is a combination of lean manufacturing, agile software development, design thinking, business model design and Steve Blank’s customer development techniques. The later one will also be discussed more thoroughly in the thesis because it lays the essence of creating a successful product or service.

The vision of startup described by Blank and Dorf “is a series of untested hypotheses in need of “customer proof” (2012, 247). To use the lean startup approach, an entrepreneur has to formulate the business model hypotheses based on the vision of product or service, and then test those hypotheses using a series of minimum viable products (MVP) as illustrated on the Figure 3.

It is essential that a startup can learn as much and as fast as possible. Ries calls this the Build-Measure-Learn feedback loop which has the aim to test and validate all important business

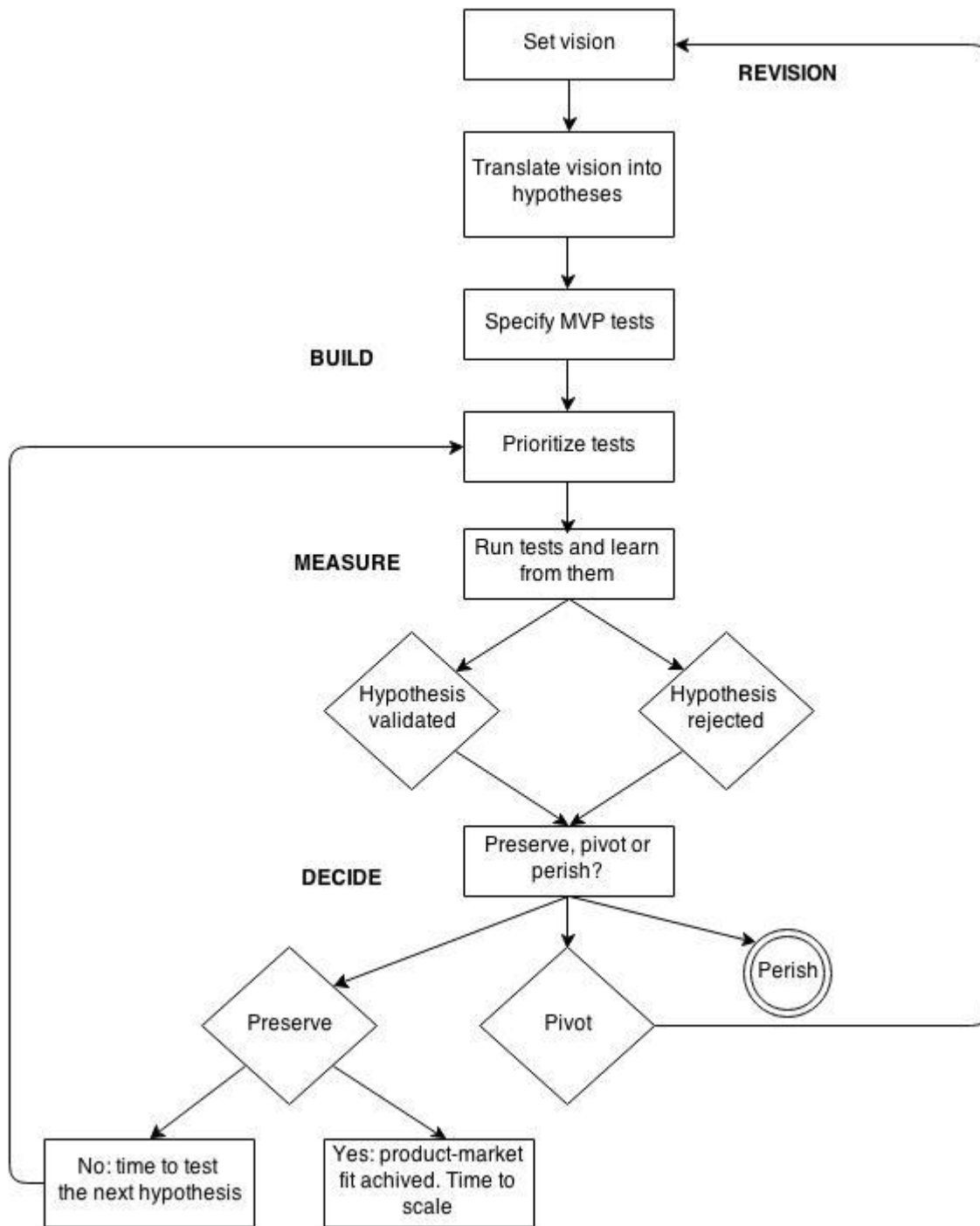


Figure 3. Hypothesis-driven entrepreneurship process steps. (Source: Dillard, Eisenmann, Ries, 2013)

assumptions. This requires that the stated hypothesis are clearly testable - they can be approved or disapproved with various experiments and results can be measurable to collect important data for decision making. The process will guarantee validated learning by demonstrating empirically that a team has discovered valuable truths about startup's present and future business prospects (Ries 2011, 38). The aim is to understand which activities are creating value for the team and which are just wasting valuable resources. The effort that is not absolutely necessary for learning what customers want can be eliminated.

Based on test feedback, an entrepreneur must decide whether to persevere with proposed business model; pivot to a revised model or the hardest decision for every entrepreneur - perish, abandon the new venture. The process has to be repeated until all of the key business model hypotheses have been validated. When the hypotheses are validated the startup will achieve problem-solution fit and after that product-market fit - it has a product that meets the needs of the target market's customers, and has enough traction to generate repeatable sales (Dillard jt 2013). The goal is to achieve a repeatable and also scalable sales model.

Lean startup combines methodologies that have proven to be an effective way to bring a new successful venture to the market. Successful startups like Dropbox, Groupon as well as established corporations like General Electric, Intuit and Qualcomm have used and are using the principles to develop and bring new product to market (Blank 2013; Lean Startup Case Studies). The main reason why this approach was used in the project subject for this thesis is the iterative and experimental manner of the Lean startup. There are many variables in the development process of an analytics product that need to be validated. Who is the customer - is it the student or the parent? What kind of problems does the customer have? What is the best solution to solve these problems? Which is the best channel to offer the solution - through coaching institutes or have a direct contact with the students? If and how much is the customer willing to pay? These are only some of the fundamental questions the startup had to answer. The best way for doing this is the Lean startup iterative approach with clear and focused steps. What exactly are these steps will be discussed further in the following chapter.

2.2 Customer Development

2.2.1 Overview of Customer Development

Customer development, an iterative framework developed and introduced by Steve Blank, is the foundation of the lean startup methodology. It is centered around testing hypotheses with an end goal to achieve scalable and profitable business. It is about questioning the core business assumptions by applying a scientific method with these main steps (Cooper, Vlaskovits 2010):

1. observing and describing a phenomenon;
2. formulating a hypothesis to explain the phenomenon;
3. using a hypothesis to predict the results of new observations;
4. measuring prediction performance based on experimental tests.

Customer development has four iterative phases (see Figure 4.) meaning if the hypotheses in the phase are not validated the process begins from the start:

1. **Customer discovery** - the aim of the first phase is to achieve problem-solution fit by understanding and learning who are the customers, learning that the problem really exists for them and understanding that the solution solves the customers problem.
2. **Customer validation** - the goal of the second phase is to achieve product-market fit. This means that the business model is validated - the product or service will generate enough sales to build a profitable company. In other words it is validated that the customers really need the product and are willing to pay for it. Marc Andreessen, famed entrepreneur and the founder of Netscape, has said that “The only thing that matters is getting to product-market fit”. Andreessen describes market as the most important factor that will influence startup’s success or failure. In a market with many real potential customers, the market pulls the product out of the startup. Conversely, in a terrible market, an excellent product and team will not matter because there are no customer who would be interested in the product. (2007)
3. **Customer creation** - after reaching two first goals the company can concentrate on scaling by attracting a large number of customers, meaning that the business is scalable through a repeatable sales process (Cooper, Vlaskovits 2010).

4. **Company building** - in this stage company departments and operational processes are created to support scale (ibid, 17). The focus is still on the validated business model.

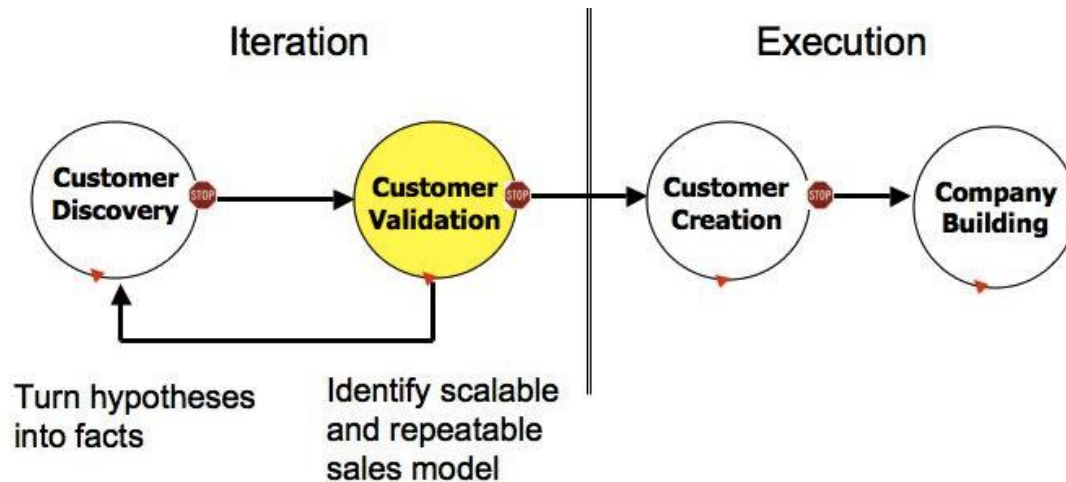


Figure 4. Four elements of Customer Development model. (Source: Blank 2007, 19)

Customer development helps to make right decisions based on tested and validated hypotheses, rather than untested assumptions that might result in a product or service that is not needed on the market. The focus of this thesis and the research questions is the customer discovery phase where the problem and the solution are validated. The other steps in the customer development process are not in the scope of this thesis. The authors will give a more detailed overview of customer discovery, the first phase customer development, in chapter two.

2.2.2 Market Type and Size

Understanding the market type and size is one of the key aspects in the process of starting a new venture - based on the market analysis it can be determined whether there is enough potential to turn the idea into a profitable business. Therefore it is important to have hypothesis about the market before the customer discovery, because these decisions will influences the revenue and cost calculations needed of the business model. Also different market types require different discovery, MVPs, and sales and marketing strategies. There are four main market types (Blank, Dorf 2012):

- **Existing** market - there are already other companies who are delivering products to the customers. It is possible to measure the size of the opportunity (number of current customers, total revenue, growth rate, etc.). To win on the market a company has to offer better performing solutions than the competitors. For this understanding competition and how customer use competitors products is essential.
- **New** market - it has no customers, competitors and there are no products currently serving the market. One of the main characteristics of a new market according to Steve Blank is that the definition of the market and the market itself are both unknown. This requires a different approach compared to a company entering or reframing an existing market. Companies compete in new markets not by competing and besting other companies with product features but by convincing a set of customers that the new company's market vision is real and solves real problem a different way. The key is understanding if whether a large customer base exists and whether these customers are willing to buy.
- **Re-segmented** market - some existing markets may have incumbents (e.g. Microsoft, Amazon) who have a dominant share of the market. It is very hard to win on this kind of market, unless the entering company has multiple resources of the incumbents'. It is possible to enter the market by finding ways to resegment it – that is to find characteristic of customers in an existing market that incumbents are not addressing. As the project in the center of this thesis is also entering a re-segmented market, the authors have devoted a separate paragraph for the overview.
- **Clone** market - a company copies an existing market, a proven business model too from another country. The biggest risk on a clone market is that the business behaviours might not be the same in the new host country. An example of clone market is Baidu in China which is an equivalent of Google.

There are two main strategies for entering a re-segmented market: low-cost and niche re-segmentation. With the low-cost strategy a startup is aiming to attract customers with significantly lower price and with a “good enough” product compared to current solutions on the market. The aim of a re-segmentation strategy is to address more specific needs of the customers and creating a clear competitive advantage. Therefore the startup needs to identify what needs are unmet by existing offerings and what will get customers to abandon their current suppliers. (Blank, Dorf 2012) Alcole

is also trying to create a niche within an existing market by offering a solution that addresses specific customer needs that are currently unmet. Their aim is to improve testing strategy with detailed analysis and advice that is currently done in a very basic level by the coaching institutes.

Re-segmenting to unique niche will involve long-term customer education and adoption (Blank, Dorf 2012). This can be big financial burden for the company. Therefore it is critical to know how to educate the market, how much time and finance is needed to grow the market into a sufficient size to maintain a sustainable business. This is an important insight for Alcole because they have to educate the students about the importance and influence of test taking strategy to their exam results and also how to interpret the analysis reports.

2.3 Customer Discovery

2.3.1 The Aim and Four Phases of Customer Discovery

Customer discovery, the first step of customer development, is all about validating the problem and understanding if the offered value proposition and solution matches customer's expectations. The aim is to achieve problem-solution fit. The four main phases of customer discovery are (Blank, Dorf 2012, 67):

1. deconstructing the vision into business model hypotheses;
2. test the problem;
3. test the solution;
4. verify or pivot.

2.3.2 Step One - Deconstructing the Vision Into Business Model Hypotheses

The first step of customer discovery is the deconstruction of the vision into falsifiable hypotheses. A structured way to do this, recommended by Blank and also done by the Alcole team, is to divide the business idea into the nine parts of Osterwalders business model canvas and constructing hypotheses for each part (see Figure 5.).

The key nine elements of the business model canvas that describe how the company creates, delivers and captures value are (Osterwalder, Pigneur 2010, 17):

1. **Customer segments** - every company serves one or several customer segments. These are groups of people that the company aims to reach, serve and solve their problems. When

serving multiple customer segments then at the beginning there should be clear focus - the segment that has the biggest need for the product has a higher priority. The goal is to have the most important problems as must-haves for the customer segments. Chosen customer segments must represent a big enough market given the business goals. (Maurya 2012)

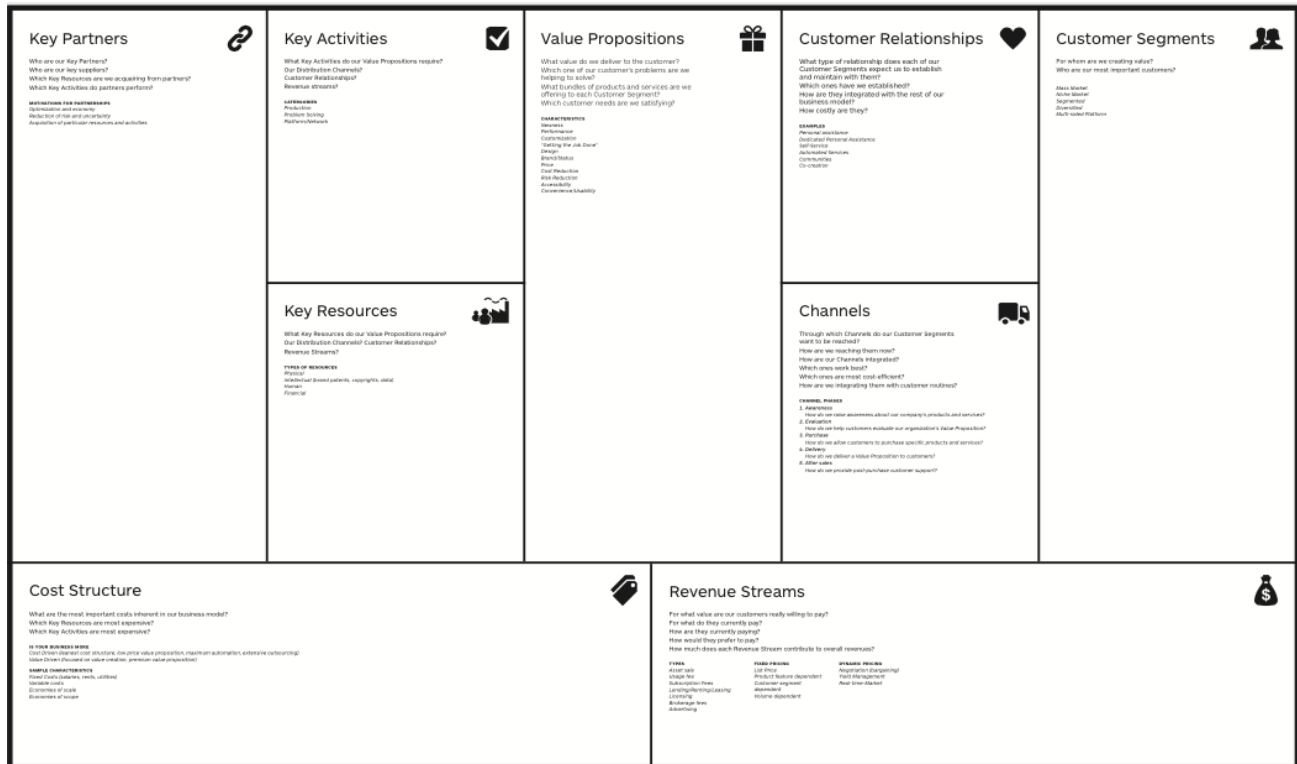


Figure 5. Nine elements of business model canvas. (Source: The Business Model Canvas)

- Value proposition** - a company seeks to solve customer problems and satisfy customer needs with value proposition. This is one of the key elements of business model canvas - without value proposition a company will not acquire customers. A good value proposition should answer the following questions. Who is your customer? What are you offering? Why should customers care?
- Channels** - value proposition is delivered to customers through communication, distribution and sales channels. Inbound channels (blogs, SEO etc.) use “pull marketing” to let customers find the service organically, while outbound channels (SEM, print / TV ads, trade shows, cold calling) rely on “push marketing” to attract customers (Maurya, 2012). To speed up the

testing and learning process it might be reasonable to approach first customer segments that have the easiest access. (Maurya 2012)

4. **Customer relationships** - for every customer segment there should be a strategy how to get customers, keep customers and grow existing customers. It can vary from personal to automated strategy. It is important to understand the expectations of the customers and based on that choosing the most cost-effective strategy. Both channels and customer relationship have an big impact on the overall customer experience and satisfaction.
5. **Revenue streams** - revenue streams result from the successfully offered value proposition to the clients. A company must understand for what value, how much and which way are the customers willing to pay. This defines possible pricing mechanisms. Customer segment that allows to maximize the margins should have a higher priority. Higher margins mean that the number of customers can be smaller to reach break even point. (Maurya 2012)
6. **Key resources** - physical, financial, intellectual and human assets that are needed to deliver all the previous five elements and make the business model work.
7. **Key activities** - the most critical activities that the company must do to make the business model work.
8. **Key partners** - some activities are outsourced and some resources are acquired outside the company. This part of the canvas describes which are the key partners that are needed for the business model to be successful.
9. **Cost structure** - business model elements result in a cost structure of a company. The business model cost structure can be distinguished between two broad classes: value-driven (focus is on value creation and less on cost implications) and cost-driven (the goal is to minimize costs). (Osterwalder, Pigneur 2010, 41) Nevertheless it is critical to understand the fixed costs and the sales volume needed to break even.

In the first step all these nine elements are still hypotheses that have to be validated and improved in the different phases of the customer development process. Business model canvas has to have a clear focus. This might require prioritization of different aspects in the canvas. According to Maurya the aim is to “find a model with a big enough market you can reach with customers who need your product that you can build a business around” (2012). When the focus is set and hypotheses stated, it is time to make the first tests to validate the problem.

The Algole team actively used business model canvas in their customer discovery process. Main focus was kept on customer segment, value proposition, channel and revenue streams hypotheses, because these are the key elements in the first steps of customer development when a startup is still trying to validate the problem and the solution.

2.3.3 Step Two - Test The Problem

The second stage of customer discovery is all about understanding the customer and the problem. In other words, is the identified problem something that potential customers want solved, and does the solution meet those needs? The goal here is not to determine how to build the product and to get a list of feature requests. The aim is to (Blank, Cespedes, Eisenman, 2012):

- identify and understand the customer;
- determine whether the product should be built by confirming that potential customers have a strong unmet need for the proposed solution - even if they may not be fully aware of that need.

Understanding the motivation of the customer is very valuable - does the customer have a “reason to buy”? (Blank, Dorf 2012) This is influenced by many factors, but one of the most critical aspects is understanding how are the customers solving the problem today or do they even recognize the problem. This is also the case with Algole. The authors show in chapter three of the thesis that most of the students who participated in the experiments did not acknowledge that they have a problem with test taking strategy and the way it influences their exam results. Therefore Algole had to educate most the students involved in the experiments to make them perceive the value.

The best methodology to clarify and understand customers’ and their problems is to conduct face to face meetings and interview them. Steve Blank has famously said that “there are no facts inside your building, so get outside” (Blank, Dorf 2012). Meeting with the potential customers helps to understand them. Customer Development expert Alvarez says that “their current behaviour is your competition” (2014). Face to face interviews was also the main method for Algole. What frustrates or motivates the customer? How do they spend their time and money? Who makes the decisions? What are the constraints that influence the choices and actions the customer takes? How do they currently solve the problem or need? These were some of the important questions considered by the project team when conducting interviews.

How many interviews to make depends on the market, business model, interviewer etc. But it is important to seek patterns in the interview answers and also to challenge and confirm those patterns. The best indicator that enough information has been gathered is that the answers start to repeat and there is a lack of new information discovered. (Alvarez 2014)

Based on the interviews personas (customer characterization) can be developed, which can later be used to ensure that the product decisions are aligned with the customer. The customer personas should be considered as hypotheses until the strategy has shown via validated learning that the customers can be served in a sustainable way (Ries 2011, 89 - 90).

In the second phase most important business model elements are tested including customer segment, value proposition, pricing, channel strategy and sales process. The aim is to validate all the hypotheses or discard them if they wrong, and replace them with new ones. A validated hypotheses has following components (Alvarez 2014):

- the customer confirms that there is definitely a problem or pain;
- the customer believes that the problem can and should be solved;
- the customer has actively invested (effort, time, money) in trying to solve the problem;
- the customer does not have circumstances beyond his control that prevent him from trying to fix the problem or pain;
- it is possible to describe how the customer solves the problem today (Maurya 2012).

Based on insights from the interviews the business model canvas has to be updated and hypotheses approved or disapproved. Only when the hypotheses are validated it is rational to move to the next step - testing the first version of the solution with the customers.

2.3.4 Step Three - Test the Solution

The third phase of the customer discovery is about testing that the solution. The main goals of the phase are to validate:

- once again the problem;
- if the solution solves the customer problems;
- the value proposition;
- if and how much are the customers willing to pay for the solution.

This involves building the minimum viable product. As this is one of the most important aspects of the lean startup methodology the authors have devoted the following chapter to describe the process.

2.3.4.1 Minimum Viable Product

Build-Measure-Learn feedback loop (see Figure 6.) is the core part of the lean startup methodology. As the authors have already stated in the earlier chapters, the goal for the startup is to minimize the total time through the feedback loop. It is important to find the smallest set of activities needed to disprove a hypothesis.

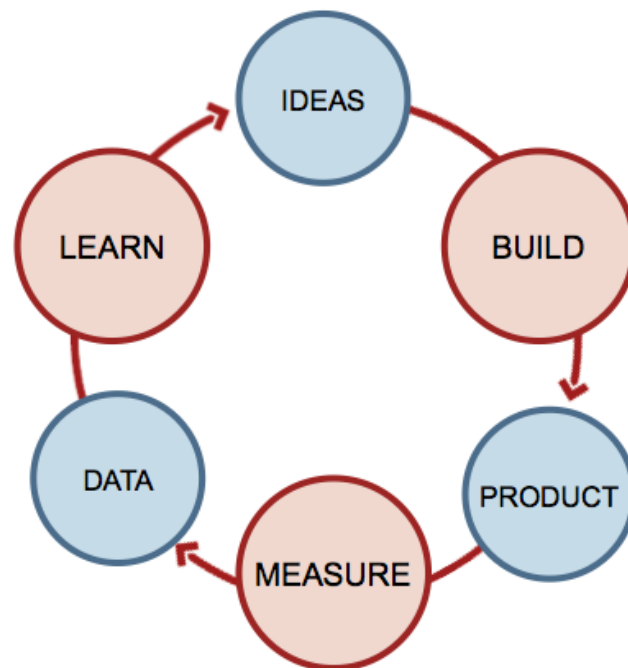


Figure 6. Eric Ries' Build-Measure-Learn feedback loop. (Source: Ries 2011, 75)

The steps of build-measure-learn feedback loop are (Ries 2011, 76-77):

1. **Build phase** - building of the MVP that enables to go through the full turn of build-measure-learn loop.

2. Measure phase - test the MVP and collect data. In this phase the most important hypotheses are tested. Eric Ries calls these the leap-of-faith assumptions. Tests have to be clearly measurable. For this key metrics have to be defined.

3. Learn phase - based on metrics conclusions have to be made if the product development efforts are leading to real progress. In the end of this phase a decision has to be made - to continue with the original strategy or pivot.

Unlike a prototype or concept test, an MVP is designed not just to answer product design or technical questions. The goal of the MVP is to begin the process of learning, understand what problems should be solved and reduce risk in the business model. All this is done by testing fundamental assumptions. (Thompson 2011) The MVP is that version of the product that enables a full turn of the Build-Measure-Learn loop with a minimum amount of effort and the least amount of development time. (Ries 2011, 77) Speed is key. The MVP lacks many features that may provide essential later on. Likewise in the second step of customer discovery, the aim is not to gather feature requests for the product but to find out whether the customer problem is understood well enough to define key elements of the solution (Blank, Dorf 2012). Every extra feature that is not essential for the learning is waste and will increase the cycle time and costs.

According to Ries it is best to find early adopters for testing the MVP. They feel the need for the product most acutely and they tend to be more forgiving of mistakes and are eager to give feedback (Ries 2011, 94). Steve Blank calls early adopters earlyevangelist - customers who are willing to pay for the product from day one. They believe in the vision of the company and are willing to make a long-term investment. Therefore when building the MVP it is important to keep in mind the needs of early adopters not the mainstream customers who are more demanding regarding the quality and features of the product. In case of Algorie the early adopters are the students who really care about the exam results. They are willing to experiment and try out new things to improve their performance. Even the smallest change in the results is important to them.

MVP has to provide enough information to prove or disapprove the hypotheses. When formulating the MVP experiment one of the key aspects is focus. It is important to identify one main key metric and focus on it. This will make the experiment clearly measurable and will provide maximum learning opportunity. Also the metric should be actionable - when something is changed

about the MVP and tested again, then the metric should also change. This means it is possible to experiment, learn and iterate. (Croll, Yoskovitz 2013)

2.3.4.2 Types of MVP

A minimum viable product is not always a smaller and cheaper version of the final product. MVP can also be a shortcut. Instead of building a real product, its possible to test the hypothesis with finding a quick hack (showing the data, prototype, demo etc). There are many different approaches how to use MVPs. Based on similar patterns Alvarez has classified them into six types (Alvarez 2014, 322 - 354):

- **Pre-Order MVP** - the aim it to get potential users to sign up and order a product or service before it is actually available. Besides the interest of the potential customers also commitment is important. It is the best way to validate if customers are willing to buy what you are offering. Kickstarter projects are could example of this - it is very effective for validating demand and financial commitment.
- **Audience building MVP** - the aim is to build up customer base before building the product. It involves creating a gathering place for customers where they can connect with other people, get information and exchange ideas. It does not validate weather customer are willing to spend money on the solution. But it is possible to measure retention and participation, which may be enough to justify an investment into developing. Forexample 37Singals and Mint.com used blogging to build up communities in advance of releasing their products.
- **Concierge MVP** - with this type MVP manual effort is used to solve the customer's problem and the customer knows that you are manually providing the service. It allows you to have a deep interaction with the customer and offer the experience before actually building the product and any features. This technique is not scalable. Concierge MVP works well for audiences that are offline and are not technologically savvy. Also with solutions where it will be capital intensive to scale up operational and technical infrastructure. Concierge MVP is not a product but more of a learning activity with and aim to validate the hypotheses.
- **Wizard of oz MVP** - version of the product that appears to be fully functional, but is actually powered by manual effort. The main difference between concierge MVP is that the

customer does not know that the process is actually manual. Like concierge method it is good for capital intensive products and potentially sensitive problem areas like finance and health. Another use case could be in two-sided markets where you can emulate one side to validate interest from the other.

- **Single use case MVP** - a working product or piece of technology that focuses on a single problem or task, which allows you to validate a single hypothesis. The aim is to one thing and do it well. With a single use case MVP customers will complain and that is a good thing. It means that customers value the product and expect it to deliver more value. Single use case MVPs work well when entering a market dominated by a larger, more complicated, more expensive product.
- **Other people's product MVP** - version of MVP where parts of an existing product or service are used to validate hypotheses. It can be a combination with wizard of oz MVP, where customers are offered a solution and then competitor's tools are used for manually fulfilling it. This is a good way to learn more about competition and discover potential advantages. This kind of MVP is useful when entering a market with established competitors and teams with limited engineering resources.

Most relevant MVP can be decided based on the hypotheses that is the aim to validate. In the project subject to the thesis was mainly concentrating on the problem and solution hypothesis. Therefore the fastest and also cheapest way to test and validate these hypotheses had to be decided. The Algole team chose to use the concierge MVP because developing a working analytics product can consume a lot of financial resources due to technical complexity.

2.3.5 Step Four - Verify or Pivot

When completing the Build-Measure-Learn feedback loop the entrepreneur has to decide whether to continue the chosen strategy or change it - pivot. It is important to verify that (Blank, Dorf, 2012):

- there is a clear understanding who is the customer and what are customer's problem and needs;
- there is a clear understanding that the value proposition solves customer's problems;
- customers will pay for the product and the price they would pay;
- resulting revenue should deliver a profitable business.

If these questions are not answered then pivot should be considered. A pivot is not a failure. It is a structured change designed to test a new fundamental hypothesis about the product and business model (Ries 2011, 178). If the decision is made to continue it has be acknowledged not until those hypotheses are validated with customers orders, they are still nothing more than educated guesses. (Blank, Dorf, 2012). This is the aim of the next step in customer development process - customer validation.

3 PHASE ONE: MARKET AND CUSTOMER RESEARCH

3.1 Introduction and Objectives

The core idea of Algole's project is to harness data analytics to boost a student's performance in the entrance examination. Monitoring and optimizing test taking strategy of students was identified as a ripe target in the whole preparation process. One way to proceed based on the lean startup methodology was to develop a basic analytics system, find first small batch of students who would be eager to subscribe to such a service. Then measure and learn the impact of this MVP on their performance and assess the possibility of building a business upon this service.

However, the team members realised that they did not possess an up to date knowledge of the market they were entering, hence the first logical step was to educate themselves about the current scenario prevailing in the coaching industry. They had no proof that the students in fact perceived their examination taking behavior as a problem and were seeking a service to improve upon it. Apart from this a lot of information was required to even develop the most basic prototype.

Based on this rationale the following objectives were decided upon for the first phase of customer discovery:

1. identify key elements in the market;
2. deconstruct Algole's broad vision into a set of testable hypothesis based on Osterwalder's business model canvas;
3. validate problem hypothesis.

3.2 Methodology

The team first identified the key elements in the market and based on this information constructed the business model canvas enlisting the hypothesis in each category. The left four columns of the canvas - key partners, key activities, key resources and costs were left out as the team felt that in the initial stage identifying the problem, customer and appropriate solution was the priority. After preparing the business model canvas the team went on to interview students, coaching institutions and collect information about entrance examination from the university. An added task during the interviews with students was to validate the problem hypothesis.

3.2.1 Identify Key Elements in the Ecosystem

Before the team could proceed gathering information about the business landscape, it was important to identify all the elements that make up this ecosystem, the relationships between these elements and their mutual interactions. Although the product would be focussed on students but like any other market the entities surrounding a customer have significant bearing on their decisions.

Each member of the team submitted a list from the top of their head to kickstart the process. After collating the list it was observed that the entities submitted had varying degree of influence on our user - the student. Also it was observed that some of the entities appeared in each member's list. In order to be thorough it was decided to brainstorm and develop a timeline of a student's life from the point she decides to pursue higher education in engineering till she receives her final result. Then enumerate all the entities she interacts with during this process. Later relationships were added between these entities and motivation for the interaction between the student and these entities.

Finally team members ranked these relationships in order of its perceived importance to the student on a scale of one to three. One being extremely important, three being an entity that can be discarded from the discussions and two for an entity that has or might have a considerable impact on our venture at any stage. All those entities ranked one by majority of the team members were picked.

3.2.2 Deconstruction of Algor's Vision Into Osterwalder's Business Model Canvas

Once the key elements in the business landscape were identified, the team developed the first business model canvas. The canvas was designed through group discussion among the team members. The following hypotheses for the business model elements were stated:

- **Customer hypothesis** - all students who are motivated and dedicated in their pursuit to clear the entrance examination for entry to top tier engineering institutes.
- **Problem hypothesis** - students make avoidable mistakes in exams which have significant impact on their final score.
- **Value proposition hypothesis** - Have a significant positive impact on the students final score to raise their all India rank.
- **Solution hypothesis** - A rudimentary analysis engine that can discover the aforementioned avoidable mistakes and provide insights to students about the flaws in their test taking strategy strategy.

- **Customer channel hypothesis** - Coaching institutions will be a viable channel to reach the students and deliver the final product.
- **Revenue hypothesis** - If the students see value in the product than either the parents or the coaching institutions will agree to pay for the services.

Definition of the terms used in hypotheses:

- **Avoidable mistake** - if the student by altering his test taking strategy can avert losing marks or gain marks on his current score, such an omission or act of commission is defined as an avoidable mistake.
- **Test taking strategy** - it is a collection of all the decisions a student takes while attempting a test ranging from the selection of questions she decides to attempt, to the order in which she decides to attempt it; budgeting of time across three subjects, format of the questions, revision; guessing strategy, time spent on filling up the bubbles on answer sheet etc.
- **Significant impact** - an improvement of 1% or higher in the final score. This number was decided based on the data from JEE 2012 which showed that an increase in 4 marks (1% of 408 the maximum marks) would raise the rank of a candidate by at least 100.
- **Motivated and dedicated students** - motivation as a psychological construct is difficult to measure. For the purpose of experimentation students with 80% or higher attendance at their respective coaching institutes are considered motivated and dedicated.

3.2.3 Preparation for Customer Research

There is no end to how much information can be collected and analysed. Also, it is important that the team members know what they are looking for when interacting with the entities. A few open ended interviews are enough to develop the big picture but afterwards a focussed inquiry is important to save resources and gather only those bits of information that are relevant to the purpose. In addition, the person conducting the interview has to have a clear idea of what they are seeking so that they can steer the interview in the desired direction.

Based on above rationale, after identification of all the entities and development of the first business model canvas, the team prepared a list of the information required for developing the first prototype. Each member picked one or two entities and listed the information they would require from that particular entity to design the first prototype. In addition each member reviewed the list

prepared by another member. In the end the list from all the members were collated. In order to operate on minimum possible resources and move quickly the collated list of required information was edited by putting it up for group discussion and voting, to pick the most relevant items.

Afterwards the team conducted a further round of open ended customer interviews and consulted the web sites of the universities to gain this required information.

3.3 Result and Analysis

Open interviews were conducted with students by asking them about various aspects of their preparation process. The questions ranged from why they decided to pursue engineering to what was their daily routine. What do they enjoy about the process, what they dislike, what are the problems they come across and how do they solve it. The team focused on how students approached their mock examinations and if they performed any kind of analysis of their performance or had any help from an outsider in doing this. The authors present below the key entities identified in the business landscape and salient observations from the customer research interviews.

3.3.1 Entities and Their Relationship

Of all the entities enumerated, the following were identified as the ones who have most influence on the venture:

- **Student** - they are at the centre of this venture. The success of the venture ultimately depends on their desirability for the product and their motivation to work alongside the service and implement the strategies recommended to them. Lastly, it is imperative that the service has perceived influence on their test performance for the venture to succeed.
- **Family** - Parents are the customer for the venture as they are the ones who will eventually pay for the services subscribed by the students. They are also a major stakeholder in a student's choice of career and other decisions pertaining to preparation process. As India ranks high on the collectivism-individualism dimension of culture, parents and close family members have high bearing upon the career path a student selects after finishing their secondary education. It is common that if the elder sibling selects the engineering discipline, the younger one invariably follows her. A student's success serves as an important ingredient for the social status their parents.

- **Student's peers and non academic service providers** - students from all parts of India travel to and take up residence in hub cities which have many reputed coaching institutions. There are key districts in these cities which house thousands of students and multiple coaching institutions. These areas mimic a university kind of setup. The education is provided by the coaching institutes. There are no dormitories as such but most houses and apartments in these districts rent out rooms to students. Other facilities ranging from book shops, internet cafes, catering facilities, photocopy shops etc are in high density and a significant proportion of the economy of these districts is fuelled by such students.

Students spend significant part of their day in these areas and there is huge amount of interaction among them starting from their rented apartments to canteens, to cafes to the coaching institutions itself. Because students spend so much time with each other everyday, their peer group has significant influence on their decision making. Also, these informal circles serve as one of the most efficient sources for dissemination of information about new service, books, mock test series etc. among them. Lastly, these circles also serve as an emotional support system for the aspirants.

- **Coaching institutions and teachers** - the coaching institutions conduct classroom based or distance learning programmes for students in addition to their regular schooling. Their curriculum focuses on teaching fundamentals and developing skills required by a student to solve entrance examination questions. These institutes conduct weekly or fortnightly mock tests to help students prepare for the final exam. Due to the inelastic demand, the coaching industry is very competitive. They demand very high fee for their services, often more than the universities.

The teachers at these institutions command immense respect among the student community. Their recommendations on books, learning methods, problem solving skills etc. are taken at face value. The reputation of a teacher influences the enrollment figures of a coaching institution. The observed trend is that once a teacher gains a reputation in the market, she establishes her own coaching institution.

- **Universities** - the universities play the two major roles in this ecosystem. They offer the courses and programmes which the students aspire for and, they conduct the entrance examinations for allocating places in these programmes. They have a monopolistic influence

on the pattern of the exam, the syllabi, method of testing, setting up the selection criteria and all other aspects of the examination.

They constantly change the pattern of the entrance examination and the difficulty level of questions to nullify the advantage a student gains by attending professional coaching institutions.

- **Government** - in the day to day operations, the Government is almost a non-existent entity in the ecosystem but can affect the dynamics of the education industry immensely through policy making. In recent years it introduced the policy of unification of entrance examinations held by various institutes and introduced new evaluation and assessment criteria. There is nothing that can be done once a policy has been framed by the Government but it is essential to keep an eye on the developments in the sector and anticipate the changes to survive.

3.3.2 Key Problems in the Preparation Process

The students reported the following pain points in the preparation process during the interviews (see Appendix 5):

1. There is no authoritative source for the students to identify which coaching institutions to join for their preparation. They rely on recommendations from family members, relatives. One key metric is how the alumni of a coaching institute performed in their entrance examination and overall brand perception of a coaching institute.
2. Some interviewees mentioned problems regarding settling in a new city - finding apartment, catering facilities etc.
3. Some students reported difficulty in grasping new concepts and found the curriculum taught at coaching institutes tougher than the one prescribed at schools. They ask for help from peers and approach the instructors from the coaching institutes to solve this problem.
4. A few students reported that they were overwhelmed by the sheer number of topics they had to cover in order to be prepared for the final entrance examination.
5. Students reported that it was difficult to formulate a good schedule with milestones during the course of their two-year preparation.
6. Some students also reported anxiety issues and high stress environment in course of their preparation.

While students reported problems of different nature during the preparation process, the team chose not to cater to the problems that fell in the knowledge acquisition domain. The reason is that this domain is serviced by the coaching institutions and it is a very competitive environment. Secondly, a marginal improvement in test taking behavior will have more impact on student's final performance compared to improving her understanding of a few topics among the 200 they are required to master for the entrance examination. Thirdly, building the whole curriculum requires an order of magnitude more resources compared to developing a service that focuses on optimizing test taking strategy. Lastly, even if the team could come up with a service in knowledge acquisition domain, given that the service has no prior reputation it would be an uphill task to enroll students for this service. Hence the team chose to focus on the knowledge application domain which is how does a candidate approach their examination.

3.3.3 Current State of Post Examination Analysis and Performance Reporting

The following observations were made concerning students approach their examination and their current habits regarding post examination analysis of their performance.

1. The students as well as the instructors at the coaching institutes follow with extreme dogmatic belief - "all that matters in acing entrance examination is how many hours you put into your preparation and how hard you work".
2. Most students reported that they do not undertake a formal analysis of their performance in mock tests. They generally spend time discussing with their peers and instructors the questions they were unable to solve.
3. Students reported that they receive marksheets for their mock tests a week to two weeks after the tests are conducted. The marksheets have basic statistics about how much they scored, their accuracy and rank among their cohort.
4. Students reported that they were more concerned about the correct answers to the problems in the mock tests which was provided to them one or two days after the tests.
5. Students and coaching institutions are not so much concerned about the performance reporting of the mock examinations. This is reflected in the format of the marksheets they receive which contains only basic information and that too after a week or two after the

mock tests are conducted. By the time the test reports arrive, students are already busy preparing for the next mock test.

6. The mock tests are not being used as a tool to steer the learning of the candidates but more as an indicator of where a candidate stands among her peers. On occasions when students fail to answer questions from a topic the mock test might serve as a reminder that they need to revise these topics.
7. Inadvertently, after every mock test the students come to the single conclusion that they should spend more time learning and solving test problems. In best cases some of them could zero in on a particular subject or a concept in a subject where they were lagging.
8. Students lack the understanding that their performance on an exam is product of two independent factors - their conceptual knowledge and how they apply this knowledge during the examination.
9. While the students are aware of the immense competition, they lack the true picture and when asked to estimate how many ranks would they slip by losing a single mark, they underestimated the fall.

The findings above seem discouraging for starting a service that aspires to optimize test taking behavior when the students exhibit such apathy to performance reports and accord no significance to their test taking strategy on their final performance. Steve Blank terms such problems as latent problems and defines them as problems that customers are unaware of. He further suggests that startups should stay away from solving such problems and instead focus on solving active problems which he defines as problems that the customers are aware of and actively looking to solve. (Blank 2014)

This situation demands a deeper analysis. The ultimate problem for the student is to secure a place in an undergraduate programme at a top tier university of his choice. The student exhibits strong passion for solving this ultimate problem and goes through a rigorous two year preparation process. The team argued that a student's ignorance of the significance of their test taking strategy on the final score might be result of functional fixedness. To gain conclusive evidence that students would not value the importance of test taking strategy even when presented with its impact on their final score, it was imperative that a MVP should be developed and tested.

3.4 Conclusions

Following conclusions were made based on the analysis of phase one:

- **Problem hypothesis** - it is confirmed that either the students are unaware or underplay the role of their test taking strategy on their final score. The current offerings in the market do not focus on test taking strategy and the role of mock tests is limited to assessing a student's preparation.
- **Complex market** - There are multiple entities in the market with complex relationships among them. A student's decision is not his own, it is influenced by their family, their peers, their instructors and the coaching institutions they join.
- **Educating the market** - Not only students but the coaching institutions too will have to be educated about the current gap in performance reporting and its significance on a student's final performance
- **Establishing rapport with the students** - it took time to build rapport with the students and gain meaningful feedback from them. They were apprehensive of talking to the team members.

4 PHASE TWO: TESTING THE FIRST VERSION OF MVP

4.1 Overview and Objectives

The phase one revealed that students, Algone's end user, were unaware of the concept of test taking strategy and its significance on their final score. It was hypothesized that if the students were educated about this shortcoming through performance reports, they would become aware of the problem and actively look for solutions. The primary objective of this phase was to confirm this very assumption as it was central to the business model.

To test this broad assumption, it was broken down into the following distinct objectives based on Osterwalder's business model canvas:

1. Validate problem hypothesis - students make avoidable mistakes in exams which have significant impact on their final score.
2. Validate solution hypothesis - a rudimentary analysis engine that can discover the aforementioned avoidable mistakes and provide insights to students about the flaws in their test taking strategy strategy.
3. Validate customer channel hypothesis - coaching institutions will be a viable channel to reach the students and deliver the final product.
4. Collect information for the development of next version of the minimum viable product.

4.2 Methodology

To test the three set of hypothesis enumerated in the objective section, the first task was to design and develop a MVP. The only valid information available as input for the design of first MVP was results from the customer research undertaken during the first phase. This information was not sufficient and a set of assumptions were made during the design process. A substantial input for design came from the analysis of past year entrance examinations question papers. The steps and decisions taken during the design process of the MVP are described in the following sections.

4.2.1 Design and Development of the MVP

The two core components of the MVP were identified as the performance report which would communicate to the students their test taking strategy along with actionable recommendations and the analytics engine which would prepare the performance reports.

The first assumption was that a sophisticated analytics engine was not needed, a rudimentary system capable of giving enough insights about a student's performance that would help validate the first set of hypothesis was sufficient at this stage of experimentation. This assumption is inline with Ries's methodology that a startup has to learn as much and as fast as possible and complete the Build-Measure-Learn feedback loop with a minimum amount of effort and the least amount of development time

4.2.2 Design of Analytics Engine

The four key questions in development of the analytics engine were:

- What would be the input data for the engine?
- What was the required output from the engine?
- Which algorithms would be employed to generate the output?
- What technology platform was most suitable to develop such an engine?

Since the entrance examination is a pen and paper based test there is a constraint on what input data can be gathered about the student's test taking strategy. The only data available is the OMR sheet that the student fills up during the exam. The OMR sheet lacks any temporal dimension. Also, it is difficult to capture the emotional state of the students and other intrinsic variables. In light of these factors it was decided that the analytics engine would focus on gaining maximum insights from the OMR sheets and a manual analysis of the characteristic traits of the questions.

The output of an ideal analytics engine would reveal the avoidable mistakes made by the student and suggest the student a better test taking strategy. Developing a recommendation system was a big project in itself which would require specialized skills in machine learning and consume a vast amount of resources. It was decided to employ the principles of Concierge MVP and achieve this task manually. Since the complex part of generating recommendations was to be done manually, the basic statistical algorithms were sufficient to design the system.

Regarding the technology platform the most inexpensive option was to use Excel along with VBScript Macros. There was a possibility of developing the system in ‘R’ programming language but it would require more time and knowing that the system would go through multiple iterations in the coming phases, this choice was dropped. Also, Excel presented the possibility that all the project members could contribute to data analysis compared to ‘R’ where only two members had expertise.

4.2.3 Identification of Avoidable Mistakes

The project members having themselves undergone the preparation and entrance examination process decided to appear for a mock test of two hour duration in three different subjects viz. Physics, Chemistry and Mathematics. They simulated the real test taking scenario and consciously journaled what steps and decisions they took while attempting the question paper. Later the answer sheets were checked and each project member reported among other things, why they made the mistakes they made, which questions they guessed, what was their guessing strategy and how they budgeted their time. The purpose of this exercise was to collect an initial set of avoidable mistakes. During this exercise they found out that the format of the questions was an active factor in their decision making. Hence they proceeded to analyse and profile the question paper from past years to gain further insights and identify cases where there was a high probability of the student making a mistake. The analysis is attached in the Appendix 1.

4.2.4 Design of Performance Report

Even though the analytics engine was rudimentary, a lot of information could be presented to the students in the performance reports. However, in order to not overwhelm them and iteratively develop new elements to be published in the performance report the initial version was limited to 2 pages. The first version of the report is available in the (see Appendix 2). A brief summary of the included elements in the report are as follows.

The overall summary section details marks scored, questions attempted, accuracy level and the current rank of the student among their cohort. Competitor’s analysis compares the attempt and accuracy rate of the students with the top performer and two other candidates who preceded her in the rank list. Manually generated recommendations, point to a specific trait observed in their performance and suggest the student how to improve them. The subject and question wise analysis

inform students how they performed on the easy to difficult spectrum of questions. The questions are also categorized on the skill set required to solve them, for example memory, concept or numerical ability intensive. This categorization was performed manually by the subject expert in the team.

4.2.5 Experiment Setup

A top tier coaching institution would have provided with more number of test subjects with higher variance in student's profile, however the three coaching institutes that were approached were slow in their responses. Engaging with them in the experiment was equivalent to closing a sales cycle with enterprise clients. Since time was of essence a smaller coaching institute was picked which promised 50 candidates. At this stage the focus was on validating the problem, solution and channel hypothesis, the service was offered free of cost.

Five mock tests were analysed and the performance reports were presented to the students. The number of participants varied from 5 to 49. There were 16 candidates who appeared in 4/5 mock tests and five of the candidates appeared in all the mock tests. The question paper for the mock tests were set by the coaching institution itself. The filled OMR answer sheets were transferred digitally from the test center to the analytics engine. The reports were prepared overnight and sent back to the candidates next morning. The 24 hour turn around time was chosen to create maximum impact on the students.

The build-measure-learn loop was employed to evolve the performance report design. First performance report was developed based on assumptions and primary analysis of past entrance exam papers. Later, a feedback questionnaire form was gathered from the participating students at the end of the second test. The objective was to collect information from the candidates about the efficacy of report in general and the separate elements of the performance report in particular. By incorporating the data gathered from the analysis of the two tests and student's feedback the performance report was tweaked for the next two tests.

4.3 Result and Analysis

The four most prominent finding of this phase - problem with student's accuracy, issue of confounding variables in deriving reliable conclusions, value perception of the performance report

among the students and viability of coaching institutes as a customer channel is presented in the following sections.

4.3.1 Accuracy Issue

Analysis of the mock test data across five tests shows 41% of the candidates have accuracy below 50%. The Figure 7. plots number of candidates and their accuracy in the first four tests. Cumulatively, the candidates on 46 out of 113 occasions achieved an accuracy in the range of 45%-60% with an average of 53%.

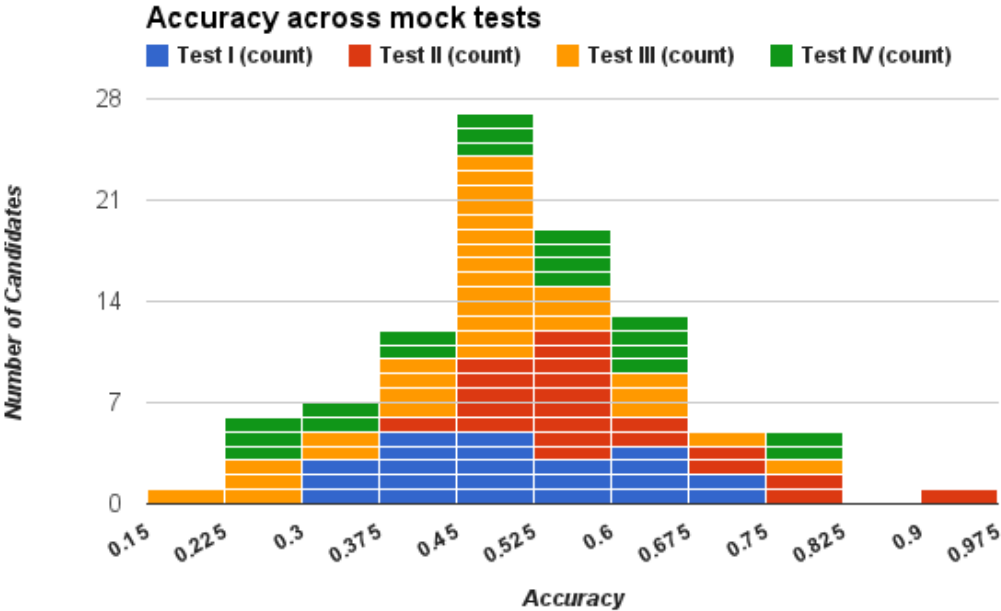


Figure 7. Accuracy chart of the first four tests.

The above observation brings up two arguments. Let's take the case of a student who has 50% accuracy and attempts 50 questions in an exam with a marking scheme +4 for correct attempt, -1 for negative attempt. Her final score would be $(50 \times 0.5 \times 4 - 50 \times 0.5 \times 1) = 75$. When one compares this score to the scenario where the student only attempts 25 questions with a 100% accuracy, she has underperformed by 25%. Further, assuming she spent equal time solving all the questions, she has wasted 50% of her time solving the questions incorrectly. So the candidate has incurred two kinds of losses. She has lost 25 marks and lost half of the allotted time for no reward because of poor accuracy. The loss magnifies from 25% to 33% when the marking scheme is (+3,-1).

Of course in a real world scenario pushing a candidate's accuracy to 100% is near to impossible. So considering another hypothetical case where the same student has improved her accuracy to 51%, keeping all other variables constant, she scores 2.5 marks more, which would boost her rank by 100 to 300 depending on her current standing in the all India merit list. The team argued that by a better selection of which questions to attempt and how many to attempt in the allotted time, the student's could improve their score.

4.3.2 Confounding Variables

The number of candidates varied from 15 to 49 across the mock tests. Only seven candidates appeared for all the mock tests. Further the mock tests unlike Graduate Management Admission Test (GMAT) or Scholastic Aptitude Test (SAT) are not standardized tests. The level of difficulty varies across tests and subjects. The Table 2 below shows the variation in average accuracy across the mock tests. In mock test 2, the chemistry paper was easier than normal. 41% of the total marks were scored in chemistry. This pushed the average accuracy of the whole test.

	Test 1	Test 2	Test 3	Test 4	Test 5
Number of candidates	22	22	49	20	15
Average attempt	50.05%	48.48%	44.58%	49.06%	45.70%
Average accuracy	50.25%	60.52%	53.31%	48.70%	58.67%

Table 2. Variation in average accuracy across the mock tests

There was no data gathered about how much work the students put in to act on the recommendation. hence it is difficult to identify which students made a focussed effort on changing their test taking strategy. Lastly, a student's performance is determined by a multitude of factors e.g. her conceptual clarity, reasoning ability, emotional state, level of preparation etc. The authors argue that unless an experiment is designed in a manner that these factors can be controlled, the contribution of test taking strategy cannot be isolated. Barring the results on accuracy, the authors find this experimental setup unreliable for arriving at any concrete conclusion using quantitative methods.

4.3.3 Value Perception of Performance Report Among Students

In their feedback form and during the group discussion students unanimously reported that they found the performance report useful. Majority of the candidates (31 out of 43) found the subject wise score sheet, the most helpful component on the performance report and a similar number demanded that the report should have an all India rank projection as this is the ultimate indicator of their performance. Students however failed to elaborate on what was the specific value they derived from the reports. Most answers were some version of ‘it is important to have a better accuracy’.

The team observed that the students who were in the top 20 percentile exhibited more enthusiasm for the report and participated actively in the group discussion about evolving the report. They also reported that they would want to continue with the service throughout their preparation. Three of these students also communicated with the team members on a regular basis over phone after the group discussions.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Coaching Institute	Q30	Q26	Q14	Q23	Q22	Q15	Q4	Q5	Q20	Q12	Q29	Q16	Q18	Q17	Q19	Q24	Q3	Q27	Q8	Q28	Q10	Q2	Q13	Q11	Q1	Q21	Q9	Q25	Q6	Q7	
1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	4	4	0	4	4	4	4	4	4	4	0	4	0	4	0
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	4	4	0	4	4	0	4	4	4	4	4	0	0	0	0	0
5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	4	0	4	0	4	0	4	4	4	4	4	0	0	0	0	0
6	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	4	0	4	0	4	0	4	4	4	4	4	0	0	0	0	0
7	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	4	0	4	0	4	0	4	4	4	4	4	0	0	0	0	0
8	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	4	0	4	0	4	0	4	4	4	4	4	0	0	0	0	0
9	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
10	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
11	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
12	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
13	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
14	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
15	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
16	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
17	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
18	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
19	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
20	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
21	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
22	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
23	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
24	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
25	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
26	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
27	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
28	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
29	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
30	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
31	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
32	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
33	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
34	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
35	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
36	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
37	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
38	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
39	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
40	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
41	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
42	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
43	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
44	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
45	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
46	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
47	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
48	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
49	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
50	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
51	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
52	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
53	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
54	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
55	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
56	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
57	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
58	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0
59	4	4	4	4	4	4	4	4	4	0	4	4	4	4	0	4	0														

denote incorrect attempt, (4) denote correct attempt and (0) denote no attempt. The team argued that the questions difficulty increases from left to right on this chart and a student not attempt the difficult questions unless 100% sure. They reported that they understood the importance of selecting certain questions to solve but were clueless about how to perform this selection. The students also asked for a separate element on the performance report that would show their past performance and indicate the change in their test taking strategies.

Most students however failed to answer, how they consumed the information available on the performance report and what activities they undertook to change their test taking strategy.

4.3.4 Efficacy of Coaching Institutes as a Viable Customer Channel

The owners of the coaching institute were interviewed about their perception of the performance report. The salient observations and reportings are enlisted below.

1. On the question of perceived value of Algone's service the owners reported:
 - Five more candidates enrolled in their test series after discovering the new performance reporting service.
 - The service helped them save time and resources in publishing the mock test results for their students.
 - They perceived an added advantage over other coaching institutes in the region and the service provided them with another feature set for their marketing purposes.
2. The owners suggested that they would be eager to subscribe to Algone's service if they could outsource the whole process of conducting mock tests. Such a service in their view would include setting up the question paper, taking care of the logistics of delivering the question paper along with OMR sheets, collection of OMR sheets and finally presenting the performance reports.
3. On question of pricing, they reported that their main concern was profit and they performed a back of the envelope calculation in front of the team showing that a fee of INR 2000 (EUR 25) per candidate for five tests would not hamper their bottom line. They added that the value for them was increase in enrollment and if there would be no effect on enrollment, it made no business sense for them to subscribe to Algone's service.

4. They seemed apprehensive of the other payment option where Algole would charge the students directly for their service. The team inferred this as the owners' concern of losing their authority.
5. The owners were skeptical about the improvement in students' performance because of the reports and termed it marginal at best.
6. The owners further added that their primary motivation was to build a profitable business and stressed that other coaching institutes too worked on the same principle. They revealed that the number of students who enroll at these coaching institutions is based on two important factors:
 - how many students from the previous batch secured top 500 ranks;
 - the individual reputation of the instructors.

Keeping these two factors in mind the performance of the majority of candidates outside of the top 500 ranks does not have a significant impact on his business.

Another prominent observation made by the team was that they had to communicate with the students via coaching institutes. Apart from the two sessions of open discussions with the students at the end of the fourth mock test all the information about student's reaction to the performance reports were communicated by the owner of the coaching institution. The first introduction about the performance reports was made by the instructors from the coaching institutes who were briefed by Algole's team. Such a setup created an inefficient channel for communication and the team perceived that it was barrier in value delivery.

4.4 Conclusions

Following conclusions were made based on the analysis of phase two:

- **Problem hypothesis is validated** - the data gathered from the mock tests provides conclusive evidence that students can score better in the exam by altering their test taking strategy. This validates the problem hypothesis that such a gap exists in the market.
- **The solution hypothesis is invalidated** - the performance report was not sufficient to make the majority of the candidates aware of this gap. It only pointed out which test taking strategy to change, but failed to deliver on how to change it. The one size fits all approach does not work, the performance report needs to be customized based on a student's profile to

maximize impact. Lastly, the performance report alone is an incomplete product and needs to be bundled with other services to impart value to the end user. This invalidates the solution hypothesis.

- **Channel hypothesis is invalidated** - coaching institutes are not concerned about the final performance of all of their students. They focus on the few bright ones, whose selection in the entrance examination guarantees them further enrollment in the successive academic year. They create a barrier between the service and the students for free flow of information. This invalidates the channel hypothesis that coaching institutions can serve as a viable customer channel.

5 PHASE THREE: TESTING THE SECOND VERSION OF MVP

5.1 Overview and Objectives

The results from the phase two only confirmed the problem hypothesis and invalidated the solution and customer channel hypothesis. Based on this the second version of business model canvas was designed. Coaching institute as a customer channel was replaced with enrolling students through direct marketing. The solution hypothesis was altered to include a new component of mentorship along with the performance reports. The mentor was tasked to:

- understand a student's profile;
- educate the student of the gap in their test taking behaviour;
- assist the student in changing her test taking strategy.

It was also decided to charge the students a fee for the service to assess the viability of the business.

The following objectives were decided for the third phase:

1. Validate the solution hypothesis:
 - a. Educating students about the impact of test taking strategy through mentors will make them aware of the problem and actively look for a solution.
 - b. Students will change their test taking strategy and show an improvement in their final score through supervision and assistance provided by mentors.
 - c. The improvement in this case will be higher compared to the earlier solution where no such mentorship was available to students.
2. Validate the customer channel hypothesis:
 - a. Enrolling students through direct marketing is a viable alternative compared to coaching institutes.
 - b. A reliable, trusted and real time communication channel can be established between the service providers and the students through such an enrollment.
3. Pricing hypothesis:
 - a. Student's are willing to pay for the service.

- b. Student's are willing to pay an amount which makes the service operationally profitable.

5.2 Methodology

In order to achieve the above objectives the team needed to spend quality time with the students face to face and observe them closely while they appeared for the mock tests. A basic setup to achieve this would be to organize a series of mock tests and hold one-to-one interviews with the students before and after the tests and hold group discussions when the performance reports were presented. While this solution would suffice but it would pose three problems.

Firstly, from previous interviews, it was evident that it took time to build rapport with the students and gain meaningful feedback from them. Holding a simple test series and monitoring was not conducive to trust building. Secondly, the objective was to gather information not just about the test taking process but other factors that influenced it. The basic setup did not provide opportunity for rich learning. Hence the team decided to conduct 'performance improvement workshop' instead. Workshop format would provide ample opportunities to the team to gain the student's trust and interact with them.

5.2.1 Design of the Workshop

5.2.1.1 Batch Size and Duration of the Workshop

The size of the batch was constrained by the available resources. There were three team members available to conduct the workshop. Apart from observing and interacting with the students, taking care of the logistics was an added task. Keeping this in mind it was decided to limit the batch size to 12 students, 4 students per team member who would also act as their personal mentor during and after the workshop.

A workshop with five mock tests spread across four weeks would have been an ideal option. However the team faced multitude of external constraints. The phase II was completed by the last week of February, 2014 and the universities were holding the first stage of entrance examination on 6th April, 2014. Post phase II analysis the team was left with four weeks to enroll students and design and conduct the workshop. There were two options either to postpone the workshop for the next academic year or conduct an intensive programme over the course of a week.

Postponing the workshop for the next academic year would cost the team four months of valuable time. Also, in case the team would find a product market fit during the workshop it would be in a position to launch the service in next academic year. Taking this into account it was decided to hold a five day workshop with three mock tests.

5.2.1.2 Setup and Aim of the Workshop

The workshop included different tasks which would help the team gather information pertaining to each of the objectives mentioned below. The schedule for the five day workshop is available in the Appendix 4. The aim of the workshop was to:

- further improve the understanding of the customer - the students;
- educate the students about the importance of test taking strategy;
- assist students in optimizing their test taking strategy;
- measure the impact on the students performance - for this three mock tests were conducted;
- gather feedback about the students' perception of the workshop.

To develop the understanding of the students a questionnaire was prepared to gather information about their perceived weak and strong concepts and their self assessment of their position on the all India merit list. Besides that there were one on one interviews and the students were offered a lecture on a topic of their choice. The purpose of the lecture was to observe student's behaviour in the classroom and gain any insight that might be useful in improving the service.

To educate the students about the significance of test taking strategy the team made various presentations including a presentation on test taking strategy, on the elements in the performance report and a presentation on the strategy of question selection and the concept of easy and difficult questions.

Another goal was to supervise and assist students in optimizing their test taking strategy. For this regular calls and status check were done by the mentors during and after the workshop. Also the students were given the assignment to identify easy and difficult questions and analyse their time sheets.

To gain feedback from the student about their perception of the service the Algole team conducted one on one interviews, group discussions and also did a questionnaire on the elements of performance report and service.

5.2.1.3 Pricing

It was decided to introduce a fee for the service in this phase. The primary reason was to validate the business model. The secondary reason was to enroll only serious students. It was observed in phase II that non serious candidates lack motivation and will to work on the recommendations and change their test taking strategy.

Being the first service of its kind without any preceding reputation in the market, charging a high fee would hinder in enrolling the students. It was decided that the priority was to validate the solution hypothesis at this stage hence a token price of INR 500 (EUR 6.5) was fixed which was 16% of the price for the final product (INR 3000, EUR 38)

5.2.1.4 Marketing and Enrollment Process

The experiment was conducted in *Kalu Sarai* district of Delhi. This region hosts over twenty coaching institutions and over 10 000 students reside in this locality. Following steps were taken for marketing:

1. banners and A1 size posters were put up in various prominent locations;
2. The canteens which serve meals to the students in tiffin boxes were engaged to distribute flyers for the workshop;
3. posters were put up in the major bookshop of the locality, *Krishna Book Depot* and an affiliate deal was agreed upon with the owner;
4. one team member frequented the locality to directly approach students and introduce them to the service.

5.3 Result and Analysis

The phase three showed positive results in two departments. Firstly, the students engaged on a deeper level with the team members which facilitated in conducting the workshop. They were comfortable in talking about their fears and shared their issues candidly with the team members. Secondly, the students were active in understanding and improving their test taking strategy.

However two other results low enrollment in the course and lack of quantitative proof of change in students performance raises question about the experiment setup. The important observations concerning the above issues are presented below.

5.3.1 Lower Than Expected Enrollment

Only five students enrolled for the workshop. The lower turnout can be interpreted as lack of interest from the students for such a service or the failure of the customer channel.

However it has to be taken into account that the marketing efforts started only 6 days before the workshop from 15th to 20th March 2014. These 6 days of marketing also coincided with the Hindu religious festival of 'Holi' (17th March) because of which a significant amount of students had travelled back to their hometown during this period. Lastly, the workshop was conducted just two weeks before the entrance examination. During direct marketing most students reported that they could not take time out for a five day workshop from their schedule during that period.

The aforementioned constraints are strong confounding variables, hence based on this data the customer channel can neither be validated or invalidated.

5.3.2 Deeper Engagement With Students

Following are the salient observations from the one on one interviews and the group discussions with the students:

- Four students reported that their study behaviour is inconsistent throughout their preparation. Their motivation, amount of study hours and confidence level varies erratically.
- The above four students confirmed that daily calls from the mentor had helped them in being more consistent during and after the workshop.
- All five students reported anxiety for the forthcoming entrance exam.
- Two students reported fear of certain topics and concepts and failed to elaborate on the cause of the fear.
- Three students reported that due to the volume of the syllabus they were in disarray regarding their revision schedule and expressed desire for a further component from the service that would help them have a well structured revision plan. A revision plan was offered by their mentors.

5.3.3 Understanding the Significance of Test Taking Strategy

All the five students completed the workshop without missing any task. Following observations highlight that the students understood the concept and importance of test taking strategy and worked actively towards solving them:

1. The students took the initiative to interact with the mentors and asked questions pertaining to improving their accuracy.
2. In the final feedback questionnaire (See Appendix 3) all students reported that performance report was integral to their experience of the workshop.
3. Four students reported that timesheet (see table 3) was the most helpful element on the performance report. It indicated them how they were budgeting their time across subjects and when were they most efficient during the mock test.

	30 minutes	60 minutes	90 minutes	120 minutes	150 minutes	180 minutes
Physics			11	6	2	
Chemistry	6	16			1	
Biology					3	8

Table 3. Questions attempted subject wise, in different 30 minute slots, by candidate number three in mock test two

4. The students exhibited better appreciation for the test taking strategy after the lecture on question selection.
5. Three students expressed that they could have benefited more from the workshop had it been organized earlier. They added that they had learnt new tools and new strategies but did not have enough time to put everything into practice for the final entrance examination.
6. All the five participants reported in the final group discussion on the last day of the workshop that they would have benefitted more had it been held earlier. They further elaborated, now they had new tools to change their test taking strategy, but not enough time to employ all the new strategies in the final entrance examination.

7. In the last questionnaire students reported that they were satisfied with the service and it helped them gain an understanding of where they stood in terms of their preparedness and how they could perform better. Four of the five participants also chose to keep in touch with their mentors post workshop. Two of them met face to face with their mentors and other two talked over the phone. Two of them needed guidance with their revision plan while one of them wanted to further talk about question selection strategy. One of the candidate requested assistance with his anxiety issues.

5.3.4 Impact on Performance

The candidates' degree of engagement and assessment of the service is in direct contrast to the quantitative results obtained. However Figure 9. shows that only one of the candidates made any significant improvement in their performance during the workshop.

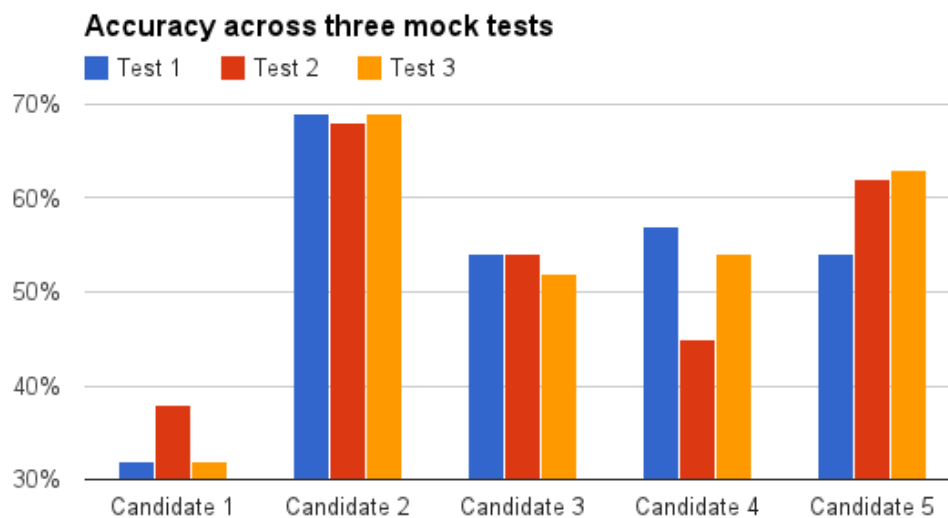


Figure 9. Accuracy across three mock tests

This contrast can be explained by the fact that the three mock tests were conducted in a span of five days and the students had only four days to assimilate and apply the new test taking strategy. The authors argue that employing new test taking strategy is equivalent to inducing a behavior change in

the subjects which cannot be achieved in such a short span of time. Further the subjects themselves reported their regret over learning these new strategies only a week before the final entrance exam indicating that they needed to practice these skills for a longer duration before they would be able to put it into practice.

5.4 Conclusions

Following conclusions were made based on the analysis of phase three:

- **Solution hypothesis is validated** - with the service of a personal mentor, the students understood the significance of their test taking strategy and worked actively to optimize it. However no significant change in performance was registered. This validates the solution hypothesis.
- **Channel hypothesis needs further testing** - While an effective communication channel between the service providers and the students was established in absence of coaching institute, the direct marketing attempt failed to enroll the target number of users. Taking into account the effect of the timing of the experiment, the customer channel hypothesis can neither be validated or invalidated. Further inquiry is needed to reach a conclusion.
- **Pricing hypothesis needs further testing** - It has been validated that students perceive value from this service and are willing to pay for it. However, due to the level of pricing it is not validated if the student's are willing to pay an amount that would make this service viable in the long run.

6 FINAL RESULTS AND DISCUSSION

6.1 Overview

In this concluding chapter of the thesis the authors collate the results from the three phases of Algole's customer discovery and present their answer to the research questions:

1. What are the specific challenges in implementing customer discovery methodology in the field of learning analytics?
2. What were flaws in Algole's customer discovery process and how they can improve it?

6.2 Challenges of Implementing Customer Development Methodology

Based on the study of the customer discovery process undertaken by Algole the authors have identified two core components of any learning analytics product. The first component observes and collects data about a specific stage of the education process - learning, assessment etc. The second component analyses this collected data and outputs insights which can be used to optimize this particular stage under observation. The authors further identified the following four key challenges that a startup in the field of learning analytics may face during their customer discovery process:

1. **Measuring the value addition of the product** - The process of learning in any individual is influenced by multitude of factors. A significant number of these factors are psychological constructs like memory, cognition, attention, perception etc. which are difficult to measure. Apart from that learning in context of formal education is a slow process. These constraints impose the big problem of isolating and measuring the impact of any single factor on learning. A startup should carefully design their experiments to arrive at reliable and valid results about the impact of their service.
2. **Sourcing seed data for validating solution hypothesis** - for the measured effect of a new product to have any statistical significance, a big sample size of seed data is required. Sourcing this seed data will be a challenge for any startup especially in the initial iterations of their product when they do not have enough customers. One way to overcome this

challenge is to engage with institutions who have access to the desired data. This further creates privacy issues and brings the startup in purview of data sharing legislations.

3. **Educating the customer** - learning analytics is a recent development and still in nascent stage. Depending on the geography of the market a startup may encounter customers who are unfamiliar with the concept of learning analytics and the value it provides. This creates an added burden on the startup to first educate the customers about their product.
4. **Multiple customer segment and value propositions** - this particular challenge is specific to startups who cater to customers from the formal education segment. They will have to deal with three different entities - students, parents and the educational institution the student is enrolled at. Depending on stage of the education either the student will be the user and customer both or just an user and parents will be the customer. If the startup's product is an addon to a service provided by the educational institution, there might be further complexity in identifying the actual customer.

In addition to that, a value proposition that serves and satisfies one customer segment might not be enough to create a sustainable business model because of the interdependence between the three entities.

The authors argue that any startup entering the field of learning analytics will at some stage of customer development face one or more of the above challenges. In order to make their process efficient a startup should perform the impact assessment of the aforementioned challenges on their product and find solutions to overcome them.

6.3 Critique and Recommendations on Algole's Customer Discovery Process

Based on the results and analysis the authors of the thesis recommend to continue with the customer discovery process before moving to the next step of the customer development methodology. Following are the critique and recommendations the authors have for the Algole's team to further validate their problem and solution hypothesis:

- **Increase the sample size of the group and add focus** - the authors argue that the most critical problem that influenced the results of customer discovery was the inferior quality of the sample group. The number of students participating in the experiments was too small. In the third phase of the project only five students participated. Such a sample size might be

reliable for exploratory studies but is too small for the purpose of validating or invalidating a hypotheses. Also the sample group consisted of students with different intellectual capacity, motivation level, conceptual mastery and there was variation in number of hours they spent for preparation etc. To collect reliable data and arrive at valid results, the authors recommend a homogeneous and bigger sample size of students.

- **Seek out early adopters** - there was not a clear strategy how to choose students to the workshop and hence where were chosen randomly. The ones who participated had a different background and motivation. The authors advice to seek out early adopters - the students who really care about the examination results, who are willing to experiment and try out new things to improve their performance. This is the best sample group for gathering feedback on the MVP to develop it further. If they find value in the service then they are willing to spread the word and will also invite other students to try out the service.
- **Further validate the pricing** - in the third phase of the experiment the Algole team decided to test the price for the service and charged a fee for their service. It is essential for any startup to validate if customers are willing to pay for the solution. The problem with the experiment was that the price asked from the students was too low. Are student willing to pay more than 500 INR? Considering that the price of the main competitors, the coaching institutes, is six times higher the team could have started with a higher price. The price should reflect the market conditions and should also be based on financial calculations - is the price large enough to make it a profitable business. This is of prime importance if Algole wants to achieve a profitable business model. The authors recommend to test various price levels on different test groups to understand and evaluate a sustainable pricing point.
- **Validate value proposition and pricing with the parents** - students' parents will eventually pay for the service. Currently it is still an assumption not a fact that they will find value in the service and hence will be willing to pay for it. Students will heavily influence their decision but the pricing needs to be tested on the parents to minimize risk and achieve further learning.

The authors recommend the team to devise clear value propositions for the parents and conduct experiments to validate these hypotheses. There are different ways for doing this.

- **Add metric for validation to each experiment** - the authors observe that the experiments conducted to test the hypothesis follow lean startup and customer development methodology in spirit only and lack the prescribed implementation details. The most remarkable of which is absence of any metric to measure the success of the experiment. None of the experiments conducted by Algole enlisted a metric and success criteria. The experiments lack a framework and appear more as a means of collecting data without any focus. There is no effort made in the experiment design to mitigate the effect of confounding variables and the inferences that the team made are ad hoc in nature.

The authors recommend that in future the purpose, the success criterion and post data collection analysis procedures should be decided before the experiment is conducted. Also the team should aim for actionable metrics so they can establish strong correlation between the changes in the MVP and the metric. These are the most fundamental requirements of a scientific inquiry and without them any results the team has arrived at are invalid.

- **Test one hypothesis at a time** - in phase 3, while conducting the workshop, the team lost the focus completely. They were trying to understand a student's profile, educate students about test taking strategy, teach them tools to change their test taking strategy and assess pricing too. By this lack of focus the team raised further barriers to gaining valid and reliable results.

The authors' view is that Algole's project is already complex by nature and team members should work in the direction of breaking down this complexity into simpler parts.

- **Identify precisely the value proposition of performance reports** - when the students in phase two group discussion were asked if they found the performance reports helpful, they agreed unanimously. The team inferred from this agreement that the performance reports were indeed adding value for the students. The authors argue that this inference is inconclusive. The students were in the habit of receiving marksheets one to two weeks after their mock tests. Algole delivered the performance reports one day after the mock test. In this scenario, it is difficult to isolate if the student found the value in the reports itself, or just the fact that they could receive their results within 24 hours.
- **Involve external agents in experiment design process** - for the purpose of identifying avoidable mistakes, the team members themselves appeared for a mock test and tried to observe their test taking strategy. In phase three, the team members carried out the design of workshop based on their own analysis. The classification of questions on the mock tests into

different categories memory intensive, numerical ability intensive and reasoning intensive was once again carried out by a team member.

The authors observe that the team relied heavily on each other for carrying out most of the analysis and design related decision. They failed to involve any external agents to validate their designs. By involving experts and advisors outside their team they could have improved their design process and validated that they were steering in the right direction. Apart from this, their current setup is vulnerable to group-think. The authors recommend Algoe to hire and engage field experts in their future design process.

- **Incorporate educational assessment principles** - the team members have carried out the performance analysis and question paper analysis based on their own reasoning and have not subscribed to formal theory of educational assessment. For example, there is absolutely no reference to Bloom's Taxonomy anywhere in their design process. There is a huge volume of academic research in the field of designing multiple choice question based exams and their efficacy. The authors are of the view that Algoe's team is losing resources by rediscovering such insights. The authors recommend that the team member's consult literature from educational assessment theory to speed up and enrich their customer discovery process.
- **Incorporate survey design theory** - the authors observe that the questionnaires used by the team for customer research interviews, lack focus. For phase one open ended interview structure is beneficial as it helps in gaining a broad view of the problem landscape but as the customer discovery progresses the questionnaires should be prepared with a specific focus and purpose in mind. The team member's made no mention of how these surveys were administered.

In light of the above facts, the authors recommend Algoe's team to consult formal survey design theory to make their data collection process through questionnaires reliable and efficient. For future experiments, the team is also suggested to be conscious of how, when and where the surveys are conducted as these factors bear significant influence on the data collected.

- **Achieve contact with a larger number of coaching institutes within various regions** - coaching institutions were approached only in New Delhi and the number of institutes contacted was small, only three. Also the coaching institutes were approached without a clear value proposition hypothesis which had an influence on the results. First a clear value

proposition hypothesis should be devised. Also authors recommend to increase the number of contacts within different regions of India. To keep focus this can be done in the later phases of the project when the hypothesis regarding students and parents are validated or invalidated.

- **Focus on re-segmented market** - when designing the experiments Algole team should keep in mind that they are entering a re-segmented market. This should be considered especially when approaching coaching institutes who are main participants on the current market.
- **Improve teamwork and commitment** - currently the team works from different locations. To achieve better chemistry with in the team the authors advise that the members should have face to face meetings periodically. Also currently all the members are working on the project part-time. To increase the progress and tempo it should be considered if some of the members could commit to the project full time.
- **Test the MVP with various segments of students** - Algole made the customer discovery experiments only with engineering students. There might be a possibility that students from other discipline exhibit different traits and a hypothesis that is invalidated with engineering students as customer segment might be valid in other case. The authors recommend that Algole tests hypotheses in other customer segments too if they cannot find a successful business model in their current market.

The authors conclude this thesis with an observation that there is a huge opportunity for academic inquiry in the field of customer development methodology by studying its application and characteristics in different sectors of the industry. The authors believe that comparative customer methodology can be an interesting subject for academic discourse.

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APPENDICES

Appendix 1 - Analysis of Past Five Years Entrance Examination Question Papers

Examination Pattern

The entrance examination is conducted in two stages. The first stage is a screening stage and around 10% of the top performing students qualify for the second stage. Only the scores on the second stage are taken into account for the final merit list. The students are informed in advance by the universities of the format of the examination.

Subjects	Either separate exams for each subject or a combination of all three
Duration of Exam	Varies from 2 to 3 hours
Number of Questions	Varies from 20 to 30 questions per subject

When a paper combines all the three subjects, a candidate has to budget her time across the subjects. From phase I interviews it was evident that some students were incapable of managing their time inefficiently.

Syllabus

Students are tested on their conceptual ability, reasoning and analytics in three subjects, viz. Physics, Chemistry and Mathematics. The syllabi mirrors the concepts taught in these subjects at higher secondary level - the final two grades in the K-12 education format.

Categorization of questions

The analysis of question papers from past years revealed that a the student had to exhibit four different kind of skills, viz. capacity for information retention, conceptual clarity, numerical ability and reasoning. Most questions require a mix of the four but based on which component has a higher weight they can be classified into three categories:

- **Memory Intensive:** These questions are fact based and requires the student to have strong information retention capability. The student can answer these questions only if she can recall the fact from their memory during the examination. There is no other alternative. A typical question in

this category would be, “Who was the first man to land on moon?” There is no way one can solve or arrive at the correct answer unless one doesn’t already know the fact that Neil Armstrong was the first man to land on moon.

- **Numerically Intensive:** Questions in this category require the student to exhibit strong numerical ability. Solving such questions often involves multiple calculation steps and compared to other two categories requires more time. Often the conceptual knowledge and formulas the student needs to know to proceed with her calculation are basic.

- **Concept & Reasoning Intensive:** These questions require the student to have strong fundamental knowledge. Such questions test the conceptual clarity of a student and how well they can apply these concepts to novel situations.

Marking Scheme

All questions irrespective of the subject and format carry equal marks. The only difference is certain categories of the question don’t penalize the student with negative marks for incorrect attempt. Students are awarded 3 marks for a correct answer, penalized 1 mark for an incorrect answer and earn 0 marks for not attempting a question.

Format of questions

The analysis of past years papers revealed that questions belonged to the following five formats:

1. **Single correct option** : These questions have four options and only one of them is correct.
2. **Multiple correct options** : These questions too have four options but the student is required to mark all the correct options ranging from one to all the four options presented. In most cases there are two correct options. These questions are set by the examiners with a motivation to test multiple concepts. They do not carry any negative marking.
3. **Assertion & Reason type questions:** Questions in this category, make an assertion statement and provide another ‘reason’ statement which explains the causation. The students are required to choose one correct option from the following four options presented, depending on the truth of the statements and the relationship between them:
 - a. Both statements are correct and the second statement is correct explanation.
 - b. Both statements are correct but the second statement is an incorrect explanation.
 - c. The assertion is true but the reason is false.
 - d. The assertion is false but the reason is true.

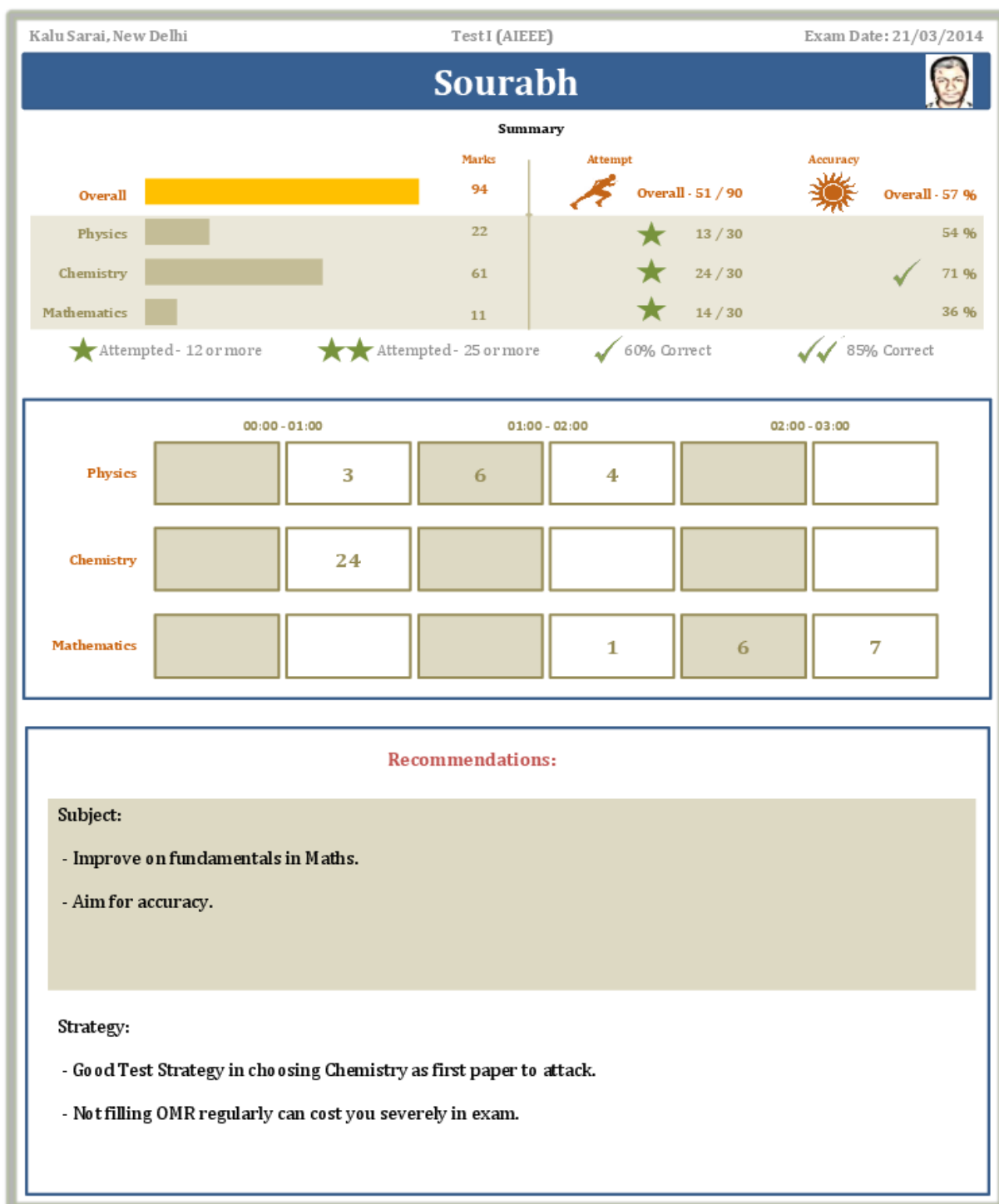
4. **Numerical answer:** Questions in this category expect the student to solve a numerical problem based on a combination of theoretical concepts and mark the final result on the optical mark recognition(OMR) sheet. The constants and numerical values involved are adjusted and normalized in such a manner that the correct answer will lie between 1 and 9 (inclusive). In some questions the students are asked to mark the ceiling value of their answer.
5. **Match the following type:** These questions enlist four pairs of related concepts in two columns and students are required to choose from four options which match the related concepts. Such questions may or may not penalize students for an incorrect attempt.

Risk Factor of Guessing:

Based on the different formats, from probabilistic theory each question has different expected value of return, if the students guesses the answer. A student might not know the correct answer but can eliminate one or two options based on his knowledge of the concept. In these circumstances a different set of expected values come into play.

Appendix 2 Sample Performance Report

Performance Report



Score Sheet

Correct

Incorrect with (-)ve Marks

Unattempted / Attempted with no (-)ve Marks

Physics 💡 Concept | ❤️ Memory | 📊 Calculations

Q30	Q26	Q14	Q23	Q22	Q15	Q4	Q20	Q29	Q16
Q25	Q18	Q19	Q3	Q27	Q8	Q28	Q7	Q2	Q13
Q11	Q1	Q5	Q21	Q17	Q9	Q12	Q24	Q10	Q6

Chemistry 💡 Concept | ❤️ Memory | 📊 Calculations

Q37	Q44	Q51	Q33	Q36	Q42	Q59	Q31	Q54	Q47
Q34	Q48	Q38	Q40	Q43	Q45	Q55	Q39	Q35	Q57
Q53	Q56	Q41	Q46	Q49	Q58	Q32	Q50	Q52	Q60

Mathematics 💡 Concept | ❤️ Memory | 📊 Calculations

Q87	Q64	Q88	Q66	Q77	Q75	Q78	Q90	Q65	Q61
Q86	Q73	Q74	Q89	Q63	Q71	Q83	Q81	Q67	Q62
Q80	Q82	Q70	Q68	Q85	Q69	Q76	Q84	Q79	Q72

Analytics powered by **ALGOLE**

For further clarifications reach to Hemant at: 09899798101

When you are not practicing, remember, someone somewhere is. And when you meet him he will win - A Roman proverb

Appendix 3 Final Feedback Questionnaire

1. What did you like the most about the workshop?
2. What should we have done more if the workshop was two weeks longer?
3. Which report format you liked more - (2-pager or 4-pager)?
4. Do you think we should keep giving the reports as a part of the workshop?
5. Which of the following sections helped you the most?
 - a. Summary
 - b. Time sheet
 - c. Recommendations
 - d. Score sheet
6. What did you achieve out of this workshop?
7. Anything else you want to say about the trainers or the course?

Appendix 4 Workshop Schedule

Day	Activity
1	Introduction: Team, Students & Project
	Presentation of demo performance report
	Group Discussion
	Questionnaire about student's profile
	Mock Test I
2	Presentation of performance report of Mock test I
	Presentation on the concept of easy & difficult questions
	One on One session with 2 students
3	Presentation on different elements of the performance report
	Group discussion on the elements of the performance report
	Mock Test II
4	Assignment in pairs - Identify easy and difficult questions

	Presentation of 6 timesheets, Assignment to analyse the time sheets and infer about the student's behavior
	One on One sessions
5	Mock Test III
	Lecture on a topic student's have problem with
	Fill up feedback forms
	Presentation of performance report for Mock test III & Motivational talk

Appendix 5 - Interview Questionnaire

1. Choice of engineering as a career
 - a. Why did you choose to appear for the IIT entrance examination?
 - b. Whom did you talk to during the decision making process?
 - c. Who inspired you?
 - d. What other options did you consider?
2. Services subscribed to for preparation
 - a. Which services have you subscribed to?
 - b. Why you chose these services?
 - c. From where did you collect information about these services?
 - d. What would you like to change about the services?
3. The preparation process
 - a. How do you prepare?
 - b. What is your daily schedule?
 - c. Whom do you approach when you are stuck?
 - d. Which family members and how much are they involved in your preparation process?
 - e. Do you have issues with emotional stability during the preparation process?
 - f. How do you solve them?
 - g. How do you spend your leisure time?
 - h. Do you have a laptop/pc/internet connection; do you use it for your studies and in what manner?
4. The mock examination process:

- a. Describe your mock exam day?
 - b. How do you choose what to study - is it just based on instructions from coaching or you try to brush up certain concepts based on your own analysis of your strength and weakness
 - c. How do you prepare for the tests at coaching, how much do you spend on each subject, do you study concepts or solve problems
 - d. Would you be interested in participating in a special study where our experts watch you attempt an exam and provide you with more insights.
 - e. How nervous are you when starting an exam, what do you do to mitigate this?
 - f. What do you do after the exam is over, hang around with friends, discuss the question paper, try solving the difficult ones at home ?
 - g. How do you attempt your test paper in general, ask them to tell you the whole story ?
 - h. How much guessing work you do ?
 - i. With 4/-1 marking scheme you attempt this much, would you change your strategy if it was 3/-1 or 2/-1 ? What if you discover in the final entrance exam that the marking scheme is 1/-1 ?
 - j. How do you rate your chances of success in the exam? What are you doing to improve it?
5. Pain points:
- a. What do you like about the preparation?
 - b. What do you dislike?
 - c. If you had one wish to change something about your preparation, what would you change?

SUMMARY IN ESTONIAN

India kõrgharidusturul ei ole nõudlus ja pakkumine tasakaalus. Igal aastal kandideerib 15 000 vabale kohale parimates ülikoolides üle miljoni inimese. Sisseastumiseksamite tulemuste põhjal valitakse välja parimad kandidaadid, kellel avaneb võimalus asuda õppima soovitud ülikoolis. Eksamitel paremate tulemuste saamiseks osalevad tudengid ettevalmistuskursustel, mida pakuvad erinevad antud valdkonna koolitusfirmad. Kuid koolitusfirmadega seotud peamine probleem on, et nende õpetamismeetodid ei võta arvesse tudengite isikuomadusi ega õppimisharjumusi. Algole on õpianalüütika süsteemi arendav iduettevõtte, mille eesmärk on aidata tudengitel saavutada eksamitel paremaid tulemusi. Selleks pakub ettevõtte tudengitele õpianalüütika teenust, mis aitab neil täiustada eksamitel ülesannete lahendamise strateegiat. Probleemi ja lahenduse valideerimiseks kasutas Algole'i meeskond Eric Ries'i *lean startup* ja Steve Blank'i *customer development* metodoloogiat.

Käesoleva magistritöö "*Customer discovery* meetodika rakendamise väljakutsed õpianalüütika tarkvara Algole näitel" eesmärk on uurida *customer development* meetodika rakendamise spetsiifilisi väljakutseid õpianalüütika valdkonnas. Lisaks uurivad autorid Algole'i meeskonna poolt tehtud vigu eelmainitud meetodika rakendamisel eesmärgiga välja pakkuda soovitusi valideeritud ärimudelini jõudmiseks. Magistritöö jaoks vajalike andmete kogumiseks viisid autorid meeskonnaga läbi intervjuud ning lisaks oli neil täielik ligipääs kõikidele Algole'i poolt eksperimentide käigus kogutud andmetele. Antud allikate põhjal annavad autorid põhjaliku ülevaate Algole'i poolt rakendatud meetoditest. Magistritöös selgunud peamised väljakutsed *customer discovery* meetodi rakendamisel õpianalüütika valdkonnas on:

- teenuste mõju mõõtmine tudengite tulemustele;
- uue teenuse tutvustamine klientidele ja probleemi olemasolu selgitamine;
- usaldusväärse andmehulga kogumine teenuse lahenduse valideerimiseks;
- mitme kliendisegmendiga tegelemine.

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