JadTek 2.0

Chris Hector
Chris Johnson
Tan Nguyen
ISM 205 Quarter Project

Project Proposal

The project partners are Chris Johnson, Tan Nguyen, and Chris Hector. The technology domain we would like to work on is the memory domain.

We plan on introducing a few new products to the marketplace that all revolve around fiber optics. The main target of our business is going to be personal computers that are used in homes, small businesses, and large business performance machines. The first product is the fabrication equipment required for assembly of fiber products like RAM and Fiber buses on motherboards. Our second product will be the first introduction of Optical RAM into the market. Upon release of our optical memory we will continue to work on the optical fabrication equipment, while improving upon our optical memory.

To develop our product we will be hiring the best employees from a variety of sources. We plan on hiring those from high tech engineering school to create the best possible products for us. In order to lure them to our company we plan on giving them part ownership rights to the company. We also plan on hiring the top recently graduated student to complement experienced professionals. These new graduates will have innovative ideas, and will motivate our experienced professionals to continue to "think outside of the box". All of our engineers will be led by excellent managers that have learned superior product development techniques from the best through the ISTM major at UCSC.

Overall Development Goals

Development Goals

The following outlines our overall development goals and strategy.

- Be the first to market with optical fabrication equipment
- Use the newly created fabrication equipment to be the first to market with optical RAM
- Incrementally revise our base products, fabrication and optical memory
- Use our knowledge of optical technology to develop optical microprocessors

Technology Strategy

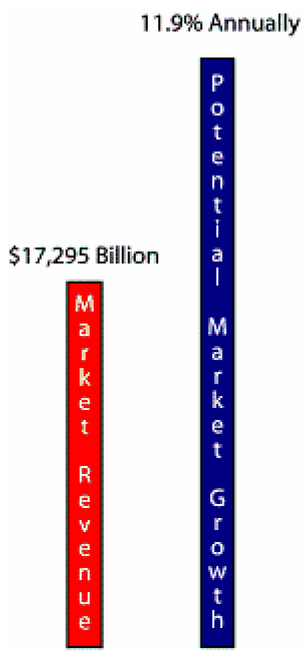
Like most technology companies, we will invest heavily in Research and Development for our product(s). We plan to be recognized for our innovations and reliability in our industry. We will address roadblocks the current RAM industry have concerning storage capacity, heat, compatibility, and speed. We will apply findings to overcome those roadblocks to our optical RAM technology. As there is not any equipment available yet for fabrication of optical component, we will first aim our efforts on fabrication technology. We have the option of developing optical memory along with fabrication technology.

Marketing Strategy

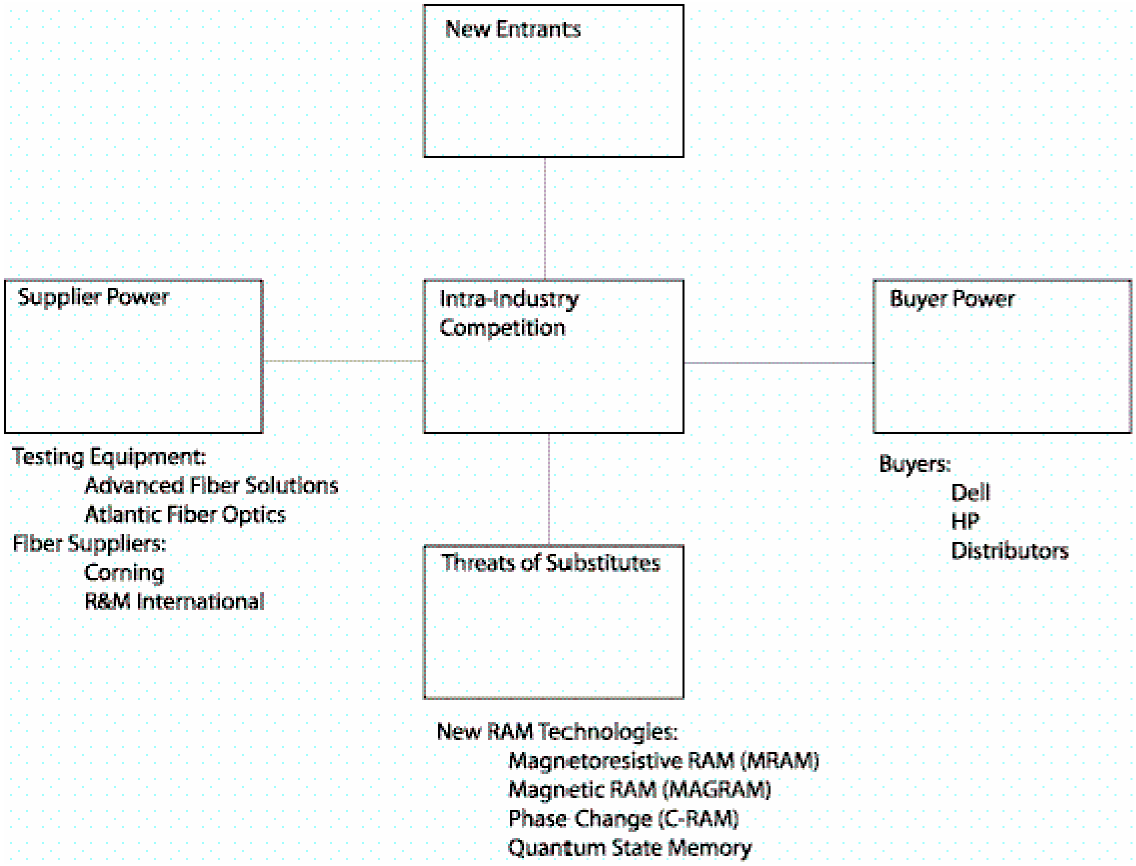
Based on the histories of technology companies, we felt it's best to start off in a highly specialized segment of the industry, optical fabrication technology. We will be pushing our fabrication technology to motherboard companies and companies making optical chips. Through our knowledge of optical fabrication technology, our next phase would be to integrate that into developing our own optical RAM technology. We will push our optical RAM technology for entrance into a new market. In this market, we will be able to accomplish several objectives: 1) compete in a small but leading edge market with relatively few competitors that 2) will enable us to develop brand name recognition and 3) enter mutually beneficial relationships with other companies (especially PC manufacturers) in the technology industry. When our brand name is firmly established in the industry (in our estimation 10+ years), we will move toward a more competitive market in optical microprocessors. By this time, we already have strong relationships with other technology companies and leading knowledge of optical technology. This will enable us to be a serious competitor in the optical microprocessor industry.

Market Sizing

The current market for optical RAM is non-existent, thus we will based our figures on an industry very much similar to ours, DRAM (Dynamic RAM). In 2002, the market for DRAM was $15,462.00B. In 2003, the market grew 11.9% to $17,295.77B. Based upon these figures, we assume our market to be approximately around $20B with an annual growth rate of 15%. Samsung is the leader in the DRAM market, with approximately 30% share. In 2003, the company raked in $4,946.10B within its DRAM business sector. We, JadTech, will assume leadership role of the market with a 35% share of the optical RAM market. This figures to be $7B in revenue. Our aspiration is to capture more than 50% of the market. We felt this figure can easily be realized because of our expertise in this technology.



Competitive Analysis



Intra-Industry Competition:
As of right now, this technology is so new that there are no companies that publish anything saying they will be introducing optical ram soon. Therefore, there are no competing companies in our industry yet. These competing companies will enter the market as New Entrants.

New Entrants:
Once companies begin to venture into optical technologies for computer components they will become new entrants into our industry.

Buyer Power:
Buyers of optical RAM will include: Dell, HP, Sun, IBM, and component distributors. These buyers will have little power over our company at first, as there is not any other company producing optical RAM. Once more companies begin developing optical RAM and other optical components the buyer's power will begin to increase.

Supplier Power:
At the beginning of our business suppliers will not have much power over us. We will be primarily working with equipment testing companies, and companies that may offer a product for our fabrication needs. As our company grows and sales of our fabrication technology take off, we will see a great increase in supplier power. When we begin producing and selling fabrication technology we will have to look into our sources better to attain the best sources for our needs.

Threats of Substitutes:
There are currently many new RAM technologies being explored by companies and developers alike. Some of these technologies will have an impact on our business when they are introduced into our market. The technologies that will have the greatest impact on our business will

probably be, Phase Change ram (C-RAM) or Quantum State Memory. These are the most technologically advanced memory techniques being worked on now.

How we play in the market:

We will be entering into a completely empty market. There are no companies that are manufacturing optical RAM. This puts us in a very lucrative position if we succeed. Our product is a new substitute for older memory technologies, and should be adopted quickly by companies with very high end memory needs. As our fabrication methods improve we will be able to offer our optical RAM to other market segments.

Risk Analysis:

Competitors and concurrent research:

University of Colorado has built a functional optical computer. It seems to me that AT&T and IBM had something to do with developing a method to store a photon, and the ability to switch photons using photons (a light switch, if you'll pardon the pun). As I recall, the computer was about the size of an executive desk, and ran at 50 Mhz. The people involved commented that as technology advanced, the system they built would resemble the old computers made of vacuum tubes, and that the same scale of miniaturization that has occurred with semiconductors could expect to be seen in optical computing.

IBM
AT&T
Quantum
Kingston
Right! http://www.pasonline.com/right/

Possibility Optical RAM won't even BE in an advanced computer
Other technology developed faster? (3D optical array storage)
Michigan State University:
http://www.cem.msu.edu/~cem181h/projects/96/memory/
Obviously many companies have their hands in this or similar products, so the research and time to market will be absolutely essential to success. Luckily, with a solid business plan the funding should be available, especially if we work with a larger company and show them we mean business.

BUSINESS FUNCTIONAL MAP

Our business enterprise is primarily composed of three main functions: engineering, manufacturing, and marketing. We place the highest priority in engineering since we want to develop the best optical RAM technology in the industry. Engineering encompasses ideas conception, product design, prototyping, product testing, etc. Once we have a working product, it is vital that we are able to gain the public’s interest and trust. This is where the marketing function of the our business comes into play. Our marketing function’s primary goal is to promote our product through variety of methods that include decisions concerning product line, pricing, formation of partnerships, and advertisement. Lastly, our manufacturing function would assess technologies in producing our products. We would address issues of efficiency, defects, and examine techniques such as Six Sigma to yield optimal results.

In the following, we address our enterprise’s three main functions and the dimensions that make up those functions.

Engineering

Our primary goal in engineering is to develop the best product through maximizing dimensions in performance, storage, and compatability. We believe that in order to maximize the value of these dimensions, we must examine critical issues that each inherently possesses. For performance, we want to maximize the speed (clock speed, data transfer rate, etc.) of optical RAM while at the same time minimize the speed of heat exerted. This is a critical issue facing the current memory industry and for our product to be successful, we must overcome this roadblock. For storage, we want to maximize the memory capacity of our products within the given standardized physical dimensions. Currently, RAM manufacturers are approaching a threshold in the amount of memory they could pack into a conventional RAM stick. We believe that our optical RAM technology will overcome this obstacle and enable us to be a market leader. In terms of compatability, we want our products to be widely utilized across various server, home, and enterprise platforms. To achieve this objective, we will aim toward developing a general optical RAM technology as the foundation for our product line following industry standards.

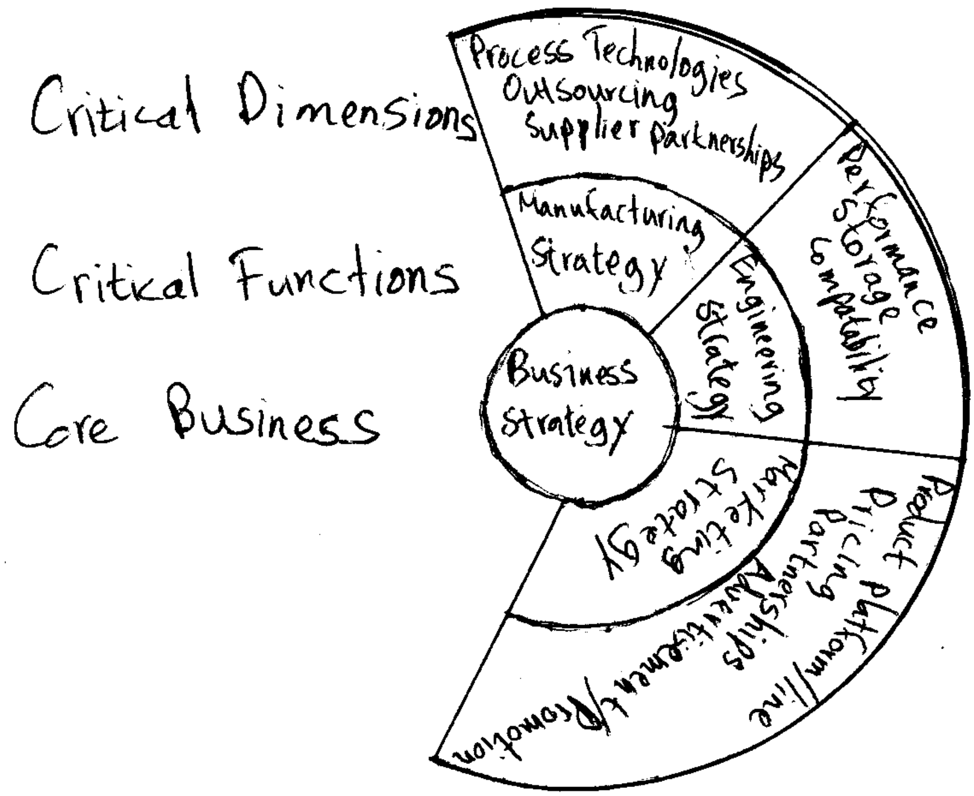
Manufacturing

For the manufacturing function of our company, we have two main objectives to accomplish. The first objective concerns the manufacturing process itself which includes process technologies. For process technologies, we must determine well-defined stages in production as well as machineries to be used during each stage. From waffer fabrication to final assembly, we will monitor each phase in the manufacturing process to maximize value by reducing costs and increasing efficiency. We will adopt techniques such as Six Sigma to minimize defects in our products and defects in the manufacturing process itself. Our second manufacturing objective deals with outsourcing. We have to decide whether to outsource certain aspects of our manufacturing process. We would like to produce every component of our product in-house, but questions of expertise and costs will incluence our desicions. An outside firm specializing in RAM assembly might be a feasible choice for outsourcing that stage in our manufacturing process. These are the decisions that must be made and we believe we will select the right choices.

Marketing

Marketing is a critical aspect of our business for several reasons. First, we must make our products appealing so that PC manufacturers would switch from conventional RAM to our optical RAM. Secondly, having the best technology alone would not make our business successful, we must convince the general public that our products are the best. For our marketing strategy, it is essential that we build good relationships with computer manufacturers. Through bundling our products with theirs, we will be able to build brand name recognition and gain trust from the industry as well as the public. Part of building good relationships with our partners is through promotions. Promotions could be giving discounts on bulk sales, or participating in computer conventions. We also want to decide upon our product line and how to advertise each product generation. We could offer upgrades to past generations of our products. Pricing is also an issue we must examine in detail in order to maximize our profit. We must look at the current industry price of competing products, the market demand for our products, and from that determine the optimal price level that would give us the highest profit.

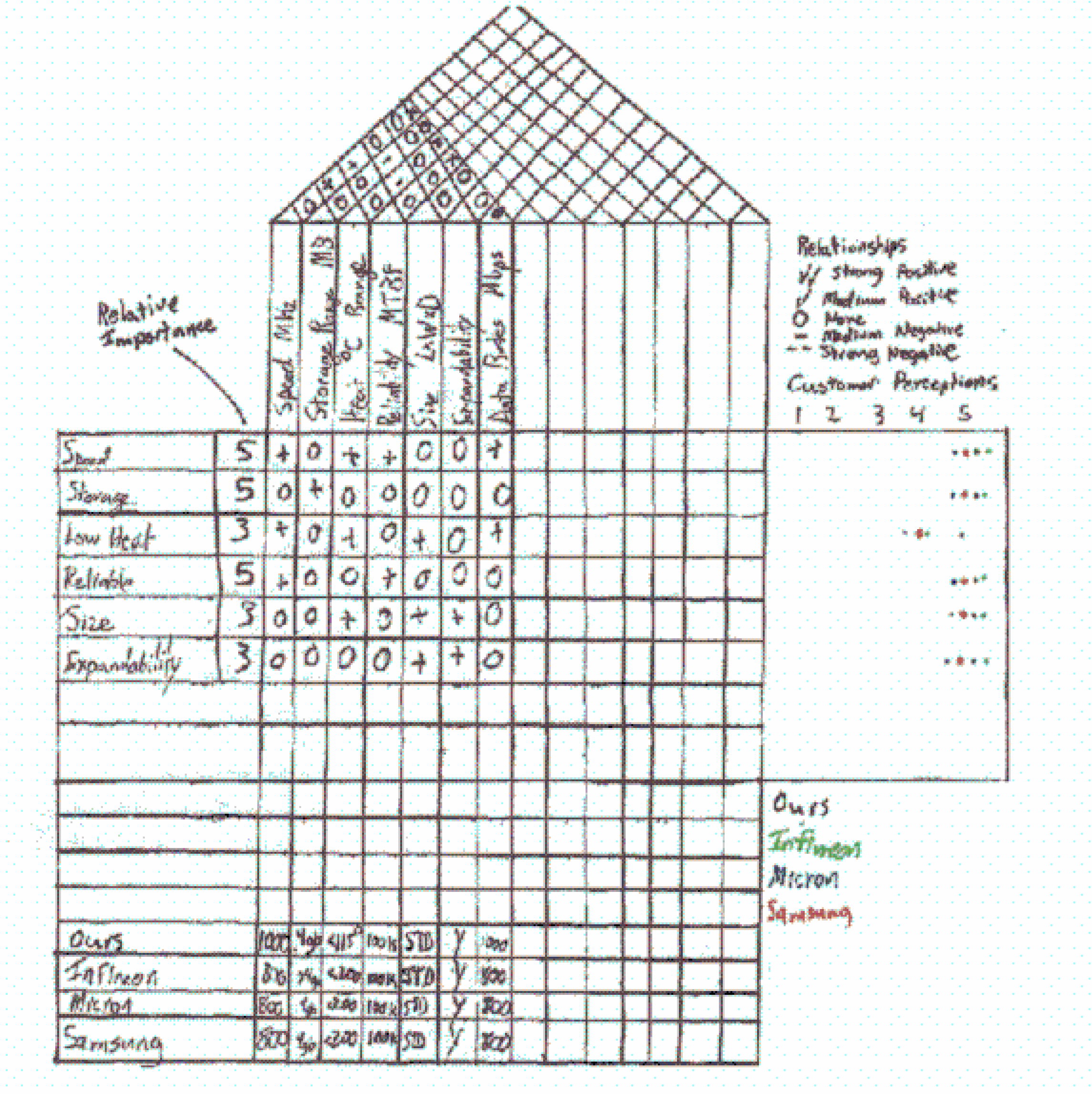
The three functions above are not islands onto themselves. They must communicate and work with each other for our business enterprise to be successful. The functional map diagram below summarizes the inter-relationships between our business enterprise, its critical functions, and the the dimensions forming those critical functions.



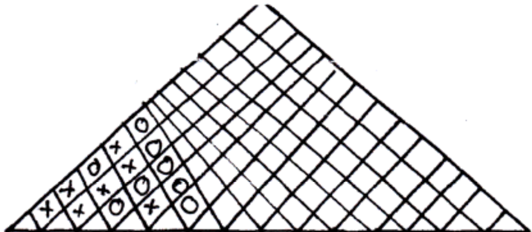
The primary driver in our industry is technology. The DRAM industry is highly competitive with an annual yield of approximately $17B. We expect our optical RAM industry to be just as competitive if not even more. Thus it is vital that we are able to stay ahead of the technological curve and put our the best and latest products onto the market.

House of Quality

HOQ: Memory



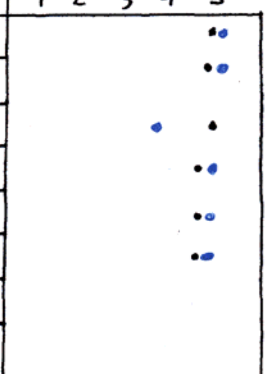
HOQ: Fabrication Equipment



		Reliability MTBF	Initial Cost $k	Maintenence $k	Density of Gates g/mm²	Speed Units/hour	Dimensions h×W×d
Reliabrlity	4		+	O	O	+	O
Initial Cost	2	+		+	+	+	O
Maintenence	2	+	+		O	O	O
Density of Gates	5	O	+	O		−	O
Speed of Prod	5	+	+	O	−		O
Dimensions	2	O	O	O	O	O	
Our Equip.		100k	$1 mill	$10 k	1,000	400	20×20×20
Their Equip (Future)		100k	$1 mill	$11 k	1,000	400	20³

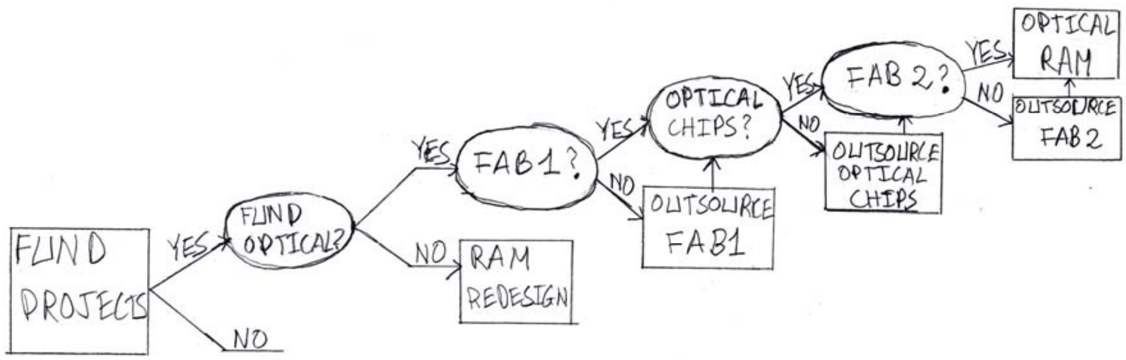
Relationships
+ Strong
O None
− Weak

Customer Perceptions
1 2 3 4 5



Ours
Theirs

Decision Analysis:

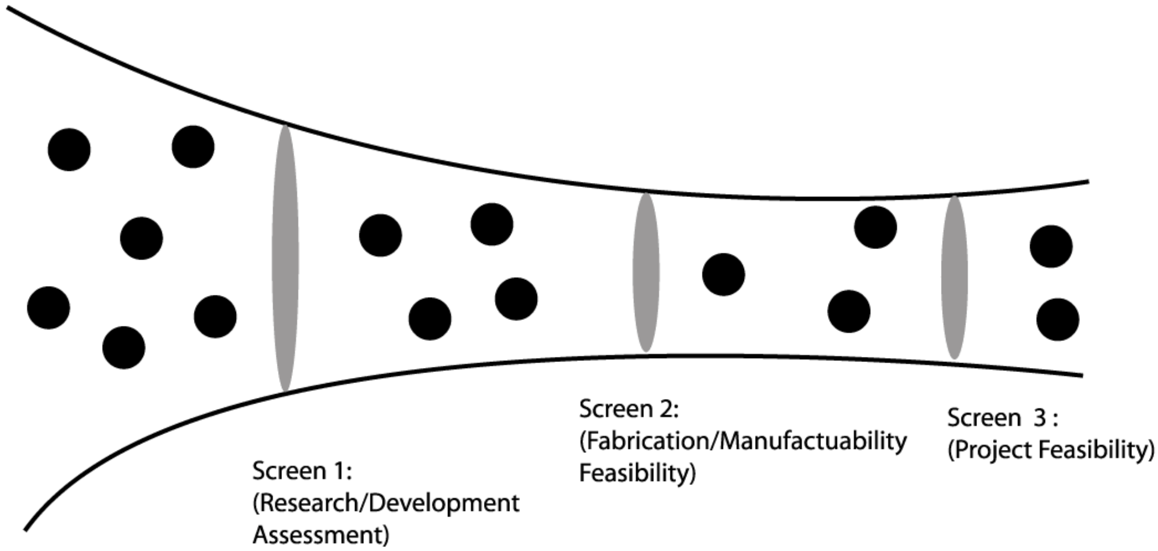


The above decision tree will help us to determine the appropriate technology strategy path for our firm. We will examine the decision tree in the following. First, we assume that our total budget is $150M and success/failure percentages are purely hypothetical.

- We first decide whether to spend money on researching/developing optical technology.
- If we decide not to, then we will examine whether to venture into redesigning the current RAM technology.
- If we decide to fund optical technology, then the next step is to determine if Fabrication 1 (mainly for chips) is a feasible choice.
- If we find Fabrication 1 to be feasible and successful, then we can proceed with creating optical chips. Otherwise, we can outsource Fabrication 1 to other firms. We have the option of using the technology from the outsourced firm to develop our optical chips.
- The next decision after developing optical chips is whether to dive into optical RAM or to have another fabrication (Fabrication 2) aimed toward optical RAM. We also have the choice of developing both concurrently.

Development Funnel:

Since we're a small company with a very specific goal, our development funnel must be solely research driven and the costs heavily pushed towards making those dreams reality. Freedom will be given in the initial stages of concept development to achieve the different goals of our project. We will accept any proposals that are feasible. The key here will be to stay on top of research and recent developments in all fields related to the project. Silicon doping with optical capabilities, gates for optical networking, motherboard improvements to use optical buses, optional optical technology that will be compact enough to fit on a mother board in a typical computer case, etc, etc.
The first screening phase will kill any possibilities that would not directly relate to the final project (optical RAM) or would require a long term research investment to complete. We need to push ahead in technology to get where we want to go and being a technology leader would not necessarily require a breakthrough in development concept but rather making an existing idea feasible.
By this time we should have a lot of small projects that will contribute to the larger whole. During the second phase we will consolidate the ideas we have and see which are the strongest. Since this is creating a product almost from scratch we'll look at the possibilities each of the ideas has to interact with other strong ideas well. If the optical connections to the motherboard work well with a specific type of silicon or other material, and so on, making our decision more on the product as a whole instead of as individual ideas.



Screen 1 Assessment Criteria:

Is this technology possible to produce?

Are the engineers/workers available and capable of creating this product?

Screen 2 Assessment Criteria:

Is the market for this product large enough to produce the product with economies of scale in mind?

Is the technology available to create the technology?

Screen 3 Assessment Criteria:

Will this product make a reasonable profit?

Is the market for this product a long term market, or will it disappear in 3-5 years?

Can this project be completed with our budget constraints?

Optimization of project portfolio

Aggregate Product Plan

The research phase of the project will primarily be concerned with the standards emerging in the optical market, which research looks to be most promising and developing relationships with the universities spearheading these operations. This will include recruitment of students in the field. The optical RAM technology will be designed concurrently with the larger fabrication equipment and we will sell time on the fabrication machinery to other companies. We will base the early core product on this development and hold off on our RAM insertion into the market until we are sure that it will be competitive. Speed is everything, but a faulty insertion would mean bad name recognition.

Fabrication

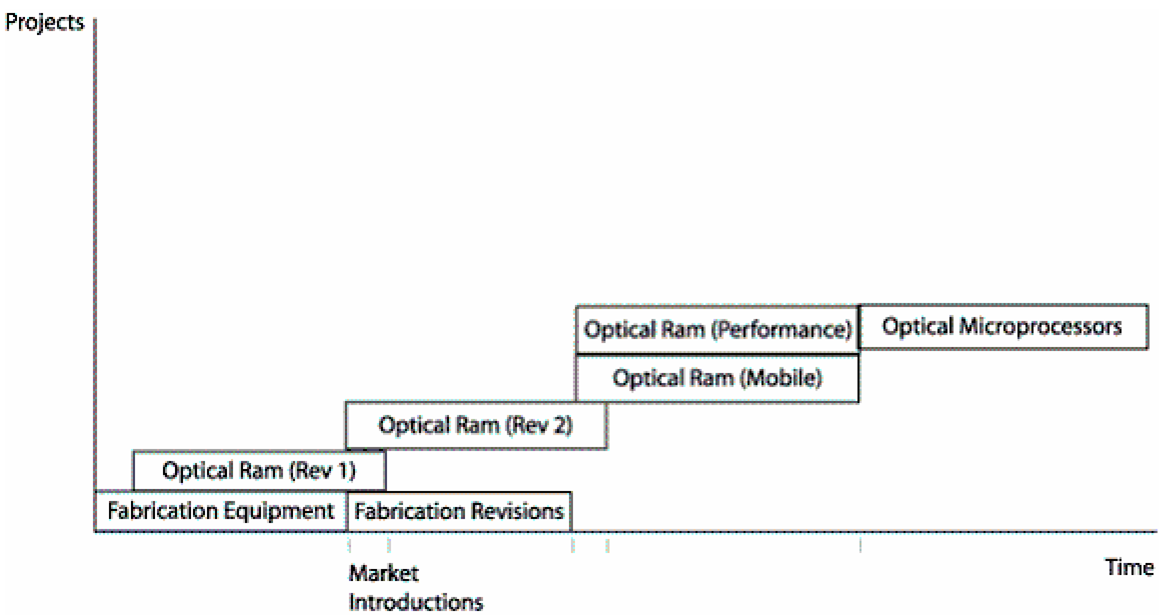
The fabrication technology will be lucrative in the short term because the next logical step as chip fabrication continues to grow faster is to eliminate the bottlenecks, one of the largest bottlenecks being the speed and other problems related to the wires themselves. Optical would eliminate many of this and create the type of speed we need to see.

Two platform enhancements will be introduced after the initial mid-sized model is completed, to be started as the final testing is being completed. The first platform will be targeted toward smaller jobs with an emphasis on fine tuning and the second will focus on mass production. Since our main product line will rely on the first platform first, that project will be started before the mass production.

We will continue to enhance the optical fabrication processes and expect to have a second revision of the core line of products done by the time the first prototype of the optical RAM is ready for more mass production. The two lines must be made concurrently.
We will focus on the technology being pushed towards standards and be prepared to re-evaluate our position in the market as the standards start to emerge, both in the microprocessor market and the motherboard market. The derivatives will follow those guidelines, incorporating technological advancements as we see fit.

Optical RAM

The second core product will be introduced with a goal of 5 years from conception of the company. This is due both to the high amount of research needed to complete this task and the uncertainty of the success of the fabrication portion.
This product will solely be performance based, it is uncertain at this time how the derivative and platform enhancements will be handled, this will be solely dictated by the market at the time of our product insertion. We will have a choice to either become a strong leader in technology or simply sell a purposefully crippled version of our product if we exceed the technology expectations of the time. Since the performance increase one would see from our product is governed not only by the raw speed of our product but of all the components of the computer, there is almost no reason to introduce the full speed version of the product immediately.
The platforms will branch off to a laptop sized chip and another high capacity or performance chip specifically for server technology.



The picture above shows the path we've chosen in order to gain strategic advantage. First we will start in a niche market of making optical fabrication equipment. Then we will integrate that knowledge into making optical RAM, and finally into optical microprocessors. In time, we may move into the "cost leadership" segment of the industry based upon our superior knowledge of the optical technology. That will depends upon the acceptance/adoption level of optical RAM/microprocessors among customers.

Conceptual design and other possibilities on the market

There are quite a few possibilities for next generation RAM technology, the real question is which one will emerge as the standard.

The big push is for further incremental improvements with the existing technology, such as the existing transistor based chip design. Many experts have warned that the technology is reaching some very critical barriers which could prevent it from improving as fast as it is. However, it has followed Moore's law quite well so far. 5-10 years from now, that's much less likely. RAM companies, instead of improving the latency of the RAM has been masking it as a problem by optimizing the cache and other portions of the software driving the RAM.

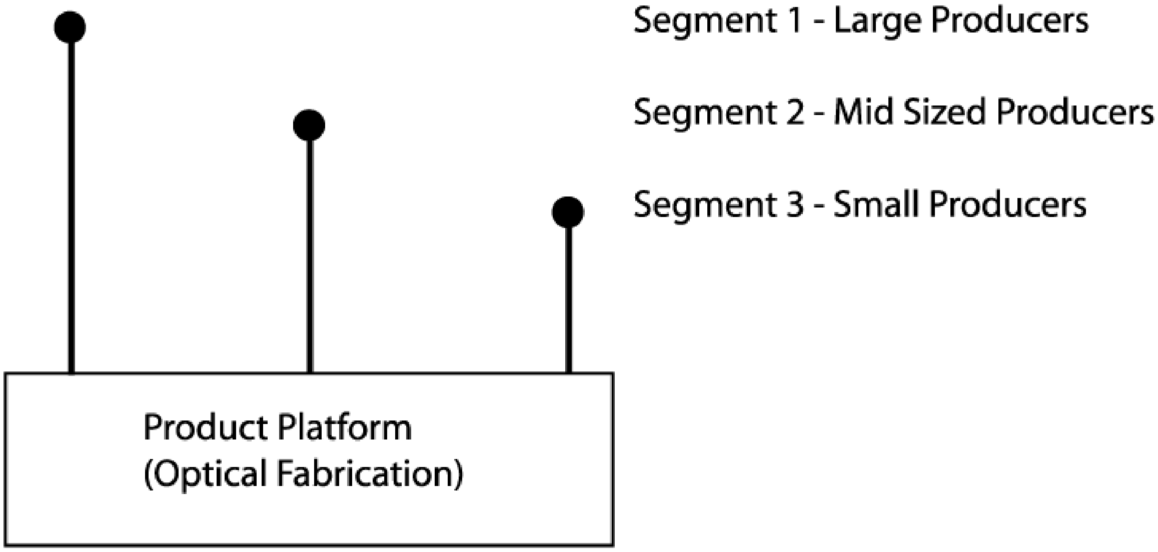
Since our customers want higher speeds and more capacity, we have to make these our priorities. However, very few mediums give us a faster propagation while allowing high storage. This leads us towards more cutting edge research. All the possible cutting edge technology high speed storage devices revolve around light in one way or another. There are two main possibilities in this area, holographic storage and optical gates.

Holographic storage uses a three dimensional crystal and stores data using a laser. It is extremely fast and has a large density storage capacity without sacrificing speed. There are still many problems to overcome, not the least of which is the manufacturing on a large scale. The technology is still being researched heavily in educational institutions.

Optical gates however have made several large leaps recently that hint the technology will be mature within 5-10 years. The problem of getting optical paths onto silicon to use more traditional fabrication methods, and optical buffers are already being used in fiber optic network systems. The groundwork has been laid for this method to be adapted to the implementation of compact and high speed storage devices.

DDR	Optical RAM	Holographic Storage
Existing technology made faster	Uses existing fabrication but new ideas and techniques	Requires new fabrication medium
Medium research and development costs, low fabrication costs	High research and development costs, medium fabrication costs	High research, development, and fabrication costs
Not much room for improvement	5-10 years to shelf, then, horizontal improvements	10-25 years to shelf, then, horizontal improvements

Product Architectures

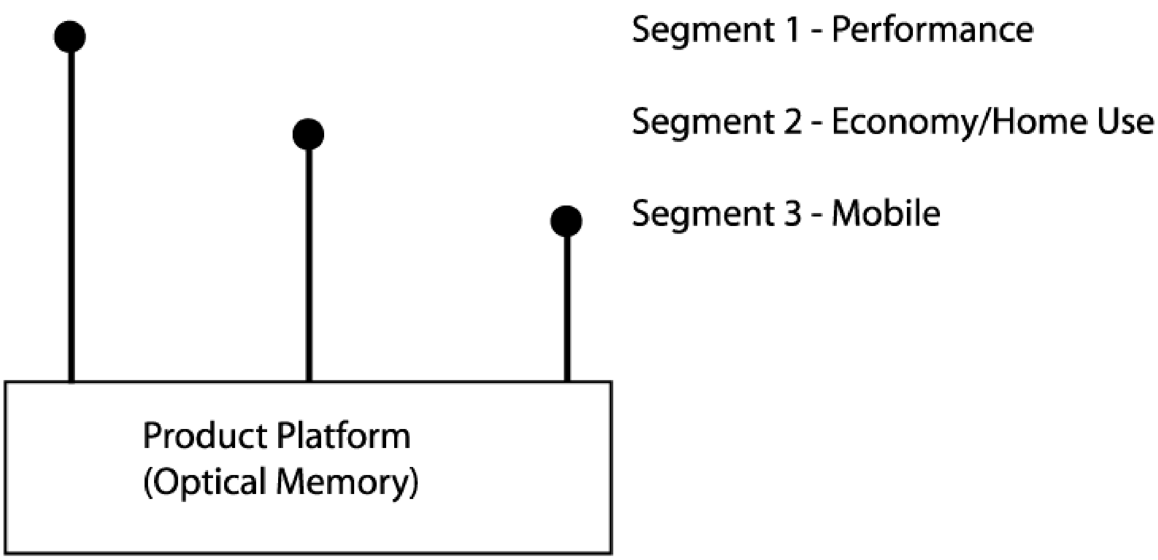


Defining Technology (Fabrication):

- Capabilities to produce optical fabrication equipment

Supporting Technology:

- Speed of production
- Gate Density

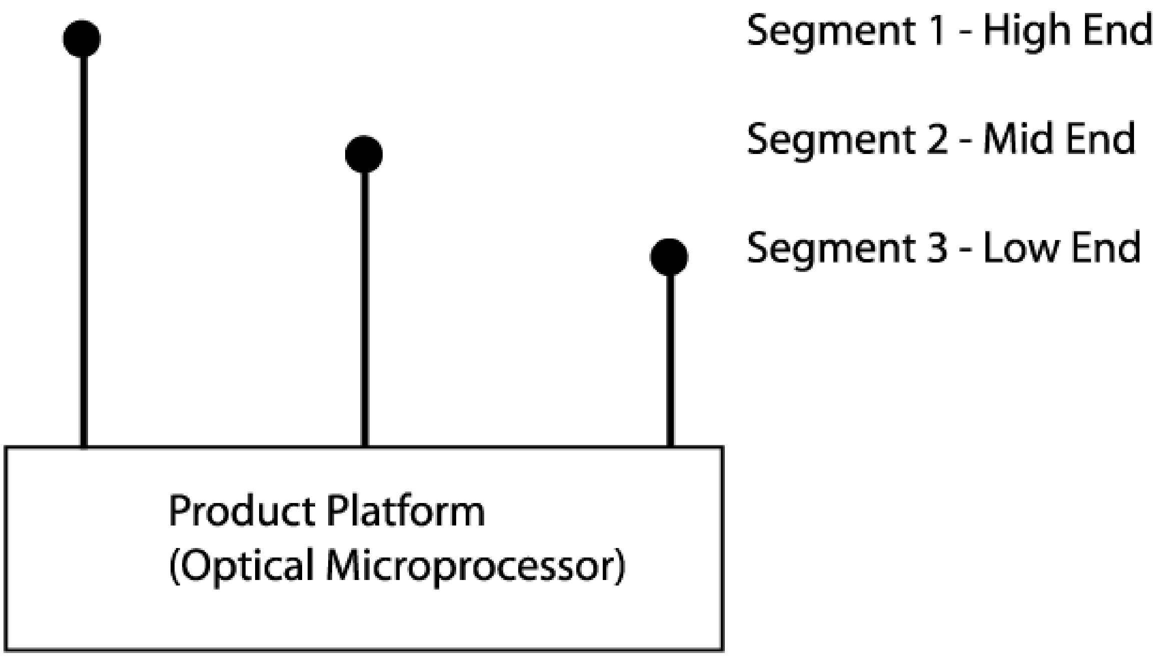


Defining Technology (Optical Memory):

- Optical Memory

Supporting Technology:

- Form Factor
- Speed
- Size



Defining Technology:

- Optical Processor

Supporting Technologies:

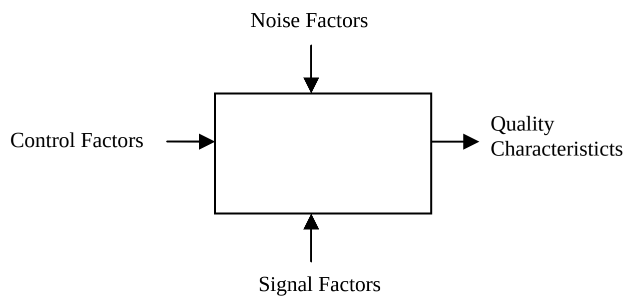
- Clock Speeds

DESIGN OF EXPERIMENTS

We will use the Design of Experiments (DOE) technique to measure quality of our product during design. DOE allows us to create and implement an efficient experimentation plan to obtain information regarding relationships between design parameters and quality. From that, we can utilize the information to derive the highest quality design.

There are various DOE software that we can use (offered by Stat-Ease, Umetrics' MODDE, etc.). However, to gain a better understanding of why we should use DOE, we will follow manual DOE procedures stated below.

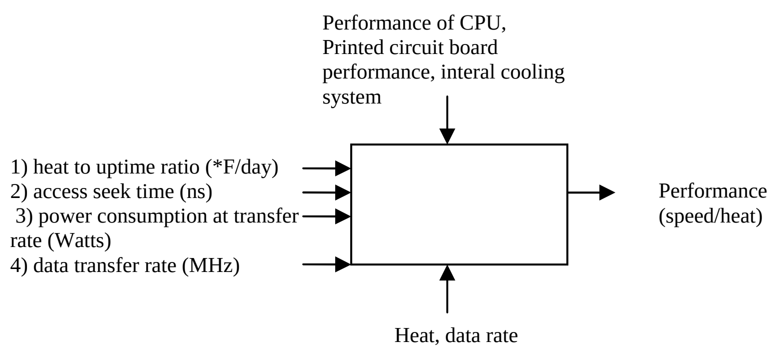
1. First, we will create a function structure with the following characteristics:
   - Signal factors
   - Control factors
   - Noise factors
   - Quality characteristic



For our purposes, we will examine the performance of our optical RAM product in terms of performance. In this DOE experiment, we define performance as (speed/heat). We want to minimize heat while maximizing the speed of our optical RAM. This is a common quality characteristic of current DRAM. We felt that our markets are similar enough that we can use this quality characteristic for our product.

For the purpose of our experiment, we choose the following parameters (these are simply examples that we could pick from; there are numerous other parameters related to our product):

Signal factors: heat, data rate
Control factors: 1) heat to uptime ratio (*F/day)
2) access seek time (ns)
3) power consumption at transfer rate (Watts)
4) data transfer rate (MHz)
Noise factors: Performance of CPU, printed circuit board performance, internal computer cooling system, etc.
Quality characteristic: Performance (speed/heat)



2. Next, we plan the experiments.
We determine the number of control factors and levels for each factor.

Heat to uptime ratio (*F/day)	1 day (H1)	7 days (H2)	30 days (H3)
Access seek time (ns)	Browsing (A1)	Gaming (A2)	Movie editing (A3)
Power consumption (Watts)	20 (P1)	30 (P2)	40 (P3)
Data transfer rate (MHz)	500 (D1)	750 (D2)	1000 (D3)

To minimize resources used, we won't be doing all of the experiments possible. We will only do certain experiments according to the provided orthogonal array chart. According to the orthogonal array, we will be doing 9 experiments.

Then we determine the signal/noise ratio to measure the quality characteristic.

For our experiments, we'll use:

3. Now we perform the 9 experiments corresponding to rows in the orthogonal array table. For each experiment, we also want to obtain the experiment's signal to noise ratio.

4. Next, we analyze the data obtained from Step (3).
This includes:
a) calculating the overal experimental mean (sum of all experiments' s/n ratio divided by number of experiments),
b) calculating the mean for each factor level (sum of each factor level's s/n ratio divided by number of occurrences by that factor level),
c) determining the effect of each factor on the mean (subtract experimental mean from mean of each factor level).

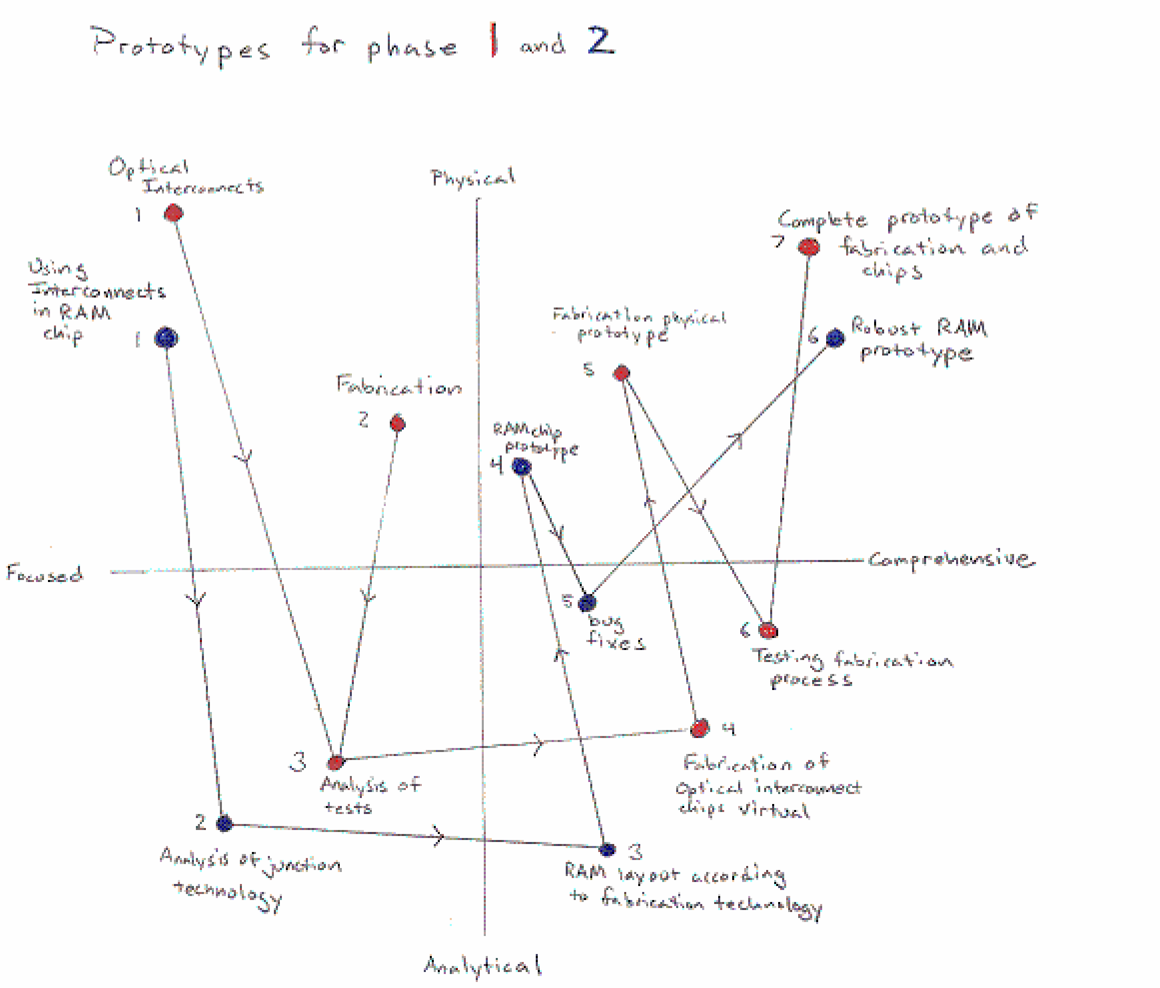
Next, we want to determine the best setting of the control factors. To do that, we need determine the best level of each factor by selecting the level with the highest value for 4(c).

Now we want to find out the optimal quality when these settings are used. To do that, we sum the overal experimental mean with values for each chosen factor level.

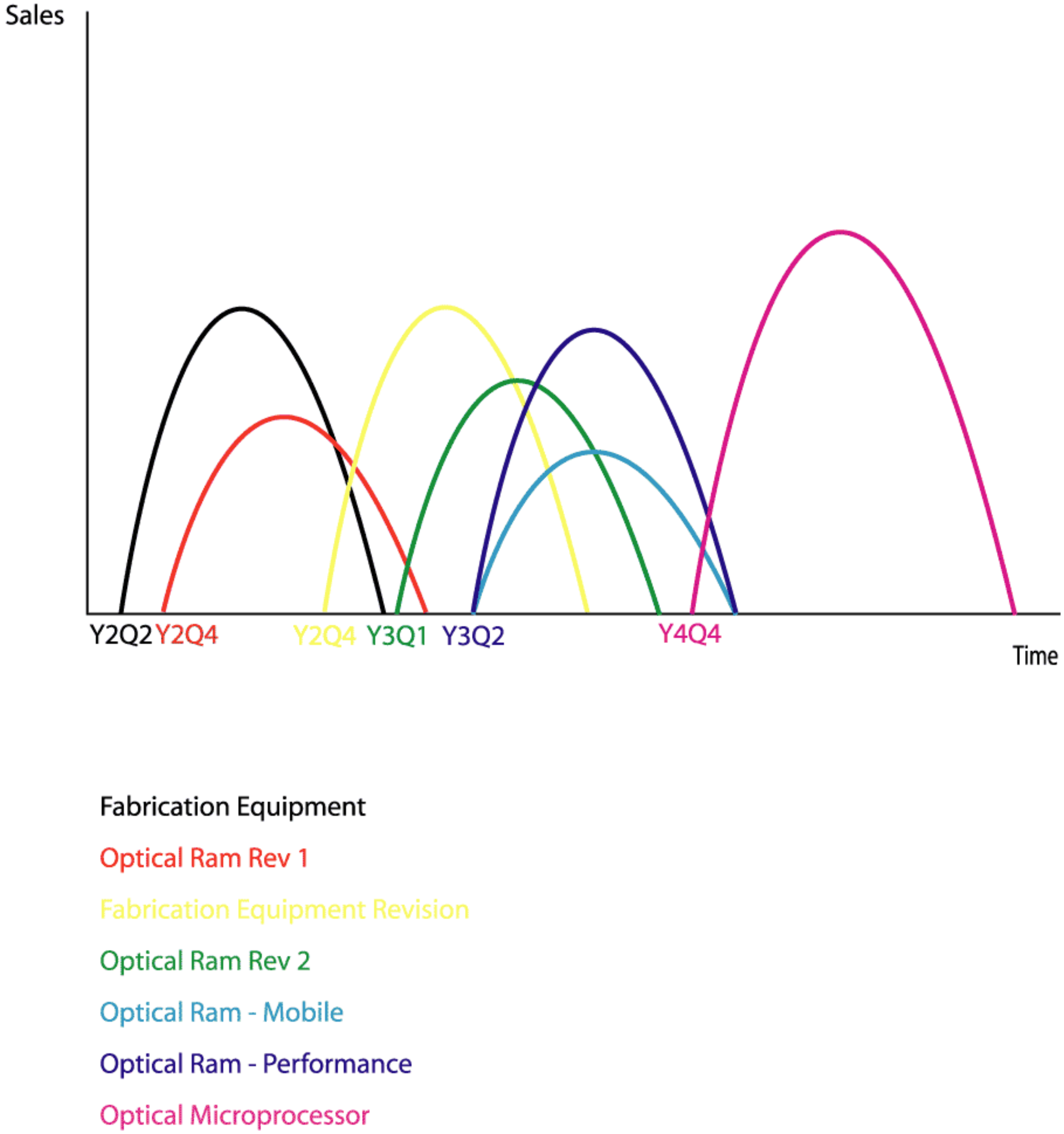
5. We could do a verification experiment using the actual factor level values to calculate the optimal mean. If the results are within our predefine experimental error, then our model applies.

By using Design of Experiments, we will maximize the overall quality of our products. We define quality here as a broad spectrum of characteristics that involve speed, life expectancy, heat exertion, compatibility, etc. These quality characteristics will combine to provide our products brand name recognition and distinction in our industry.

Prototypes


Prototypes for phase 1 and 2
Physical
Analytical
Focused
Comprehensive
1 Optical Interconnects
1 Using Interconnects in RAM chip
2 Fabrication
3 Analysis of tests
2 Analysis of junction technology
4 RAM chip prototype
5 Fabrication physical prototype
5 bug fixes
3 RAM layout according to fabrication technology
4 Fabrication of optical interconnect chips virtual
6 Testing fabrication process
6 Robust RAM prototype
7 Complete prototype of fabrication and chips

Product Release Roadmap



PROJECT SUMMARY

In order to develop products for commercialization, each firm must take actions necessary to ensure success. Our project this quarter gave us the opportunity to fill the role of such a firm and take those necessary actions. We created an optical RAM (Random Access Memory) company that will introduce the next generation of superior RAM technology.

Like most companies, we approach the industry with certain strategies in mind. These strategies are summarized in our overall development goals. They include our technology strategies (what sort of technologies will be pursuing) and marketing strategies (how will we get our product out to the consumers). These form the basis for guidelines that we will follow in terms of where our company is going to be in the future.

Next, we examine the industry itself to get a sense of what we're getting ourselves into. In this stage, we examine how big the market is (market share), and various possible forces that could have an effect on our business. These forces are summarized in our Porter's Five Forces framework.

After examining the market we're going to be a part of, we want to structure our firm's various functions so that we will be able to effectively compete in that market. We utilize functional maps in this stage to structure and clarify the tasks and responsibilities of each of our firms' various main functions such as manufacturing, marketing, and engineering. Here, using the House of Quality model will enable us to better understand our customers' needs. We transform these needs into dimensions that each of our main functions will address.

When we understand what characteristics our customers would like to see in our products, we then decide whether to produce and how we will accomplish the production. This is done by utilizing the decision analysis techniques to guide our decision making processes. Here, we examine the costs and revenues associated with each decision. This will help us to determine which projects to pursue to maximize our return on investment.

The task of choosing the most suitable projects for development is relegated to the development funnel process. We use this process to further justify our decisions obtained through decision analysis. The development funnel and decision analysis help leads us into creating an aggregate product plan for the firm.

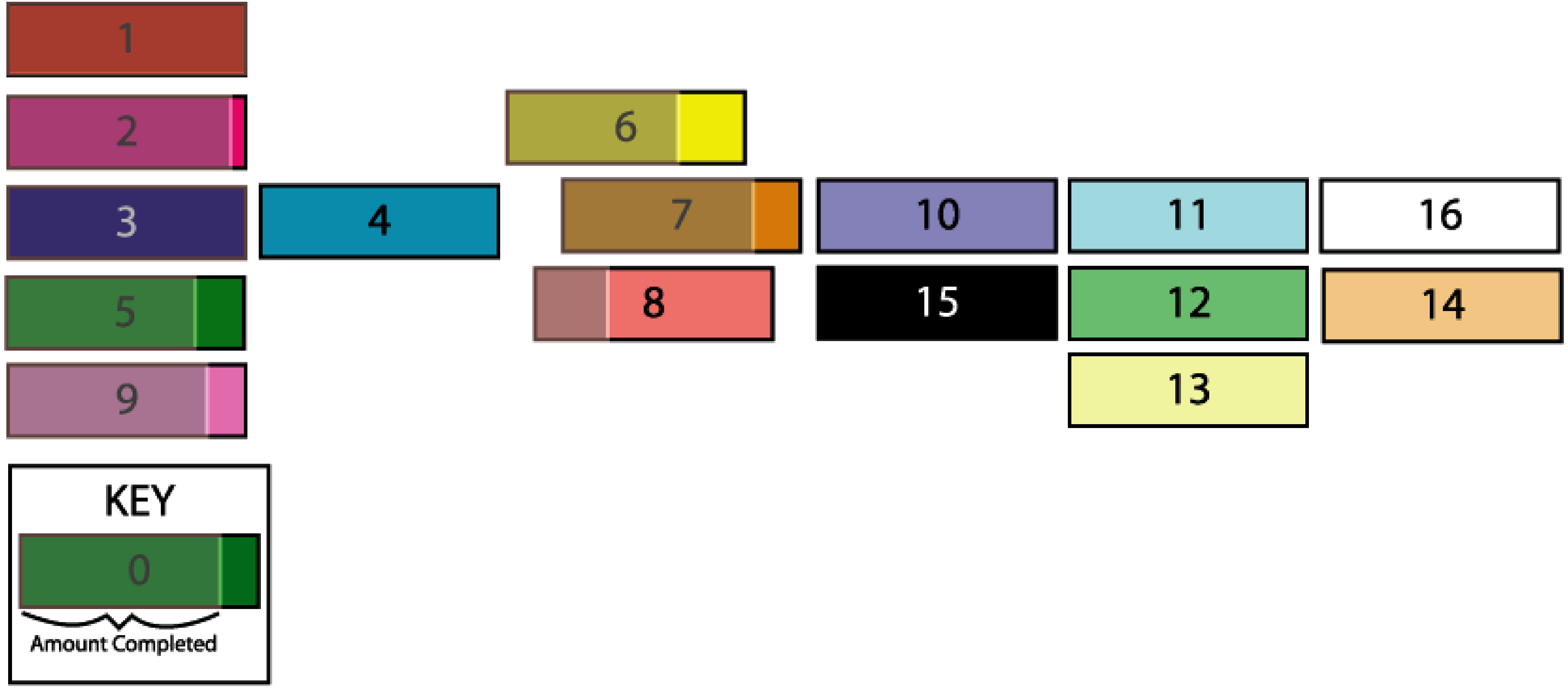
From our aggregate product plan, we select a few product platforms to pursue. We generate conceptual designs of our chosen product platforms to assist us in creating specific products lines. Using knowledge we gained from the house of quality and our conceptual designs, we construct specific product lines and corresponding supporting technologies for each line. This is outlined in our product architecture.

Once we have decided on our product lines, the next logical step would be to design these products. To maximize the quality of our designs, we perform Design of Experiments

(DOE) to obtain the best possible combinations of quality settings. After determining what those best quality settings are, we apply these settings to our prototypes.

After having functional prototypes of our products, we create a product roadmap. This roadmap will assist us in determining schedules for our product releases.

The process does not end here. There are many other issues we have to be concerned about such as the flow of our supply chain, our sales strategies, our distribution channels, etc. These are all part of the next step we must take in the commercialization of our products.



1. Map the competitive business landscape for the technology to be developed, and establish the overall technology and market strategy to achieve competitive advantage
2. Establish the business goals and objectives (ROI, %market share, revenue, and growth aspirations).
3. Define the overall development goals and objectives to align business, technology, and market strategies.
4. Create functional maps (time-based evolutionary maps) for marketing, engineering, manufacturing, to guide enterprise-level pre-project planning.
5. Identify customer needs and translate these needs into high level technical requirements (for the technology, products, and projects to be developed) using Quality Function Deployment (QFD) and the "House of Quality (HOQ)".
6. Use probabilistic decision analysis to develop an initial aggregate project plan, which is the mix of products to be developed:

" Research & advanced development
" Breakthrough
" Platform or Next Generation
" Incremental (Enhanced, derivative, hybrid)
" Alliance or partnered projects

7. Create a development funnel (identification and screening process) to refine and firm up the aggregate project plan.
8. Establish a cross-functional team for each technology project, and develop a project plan using the design/development structure matrix, PERT, CPM and GANTT charts.
9. (Technical Specifications): Perform QFD and HOQ to translate customer needs to technical metrics and specifications.
10. (Conceptual Design): Generate several design concepts and select one (or more) concepts based on a set of selection criteria.
11. (Product Architecture): Establish the technology platform, product architecture, and product lines.
12. (Prototyping/Detail design): Develop the detailed design, and build corresponding prototypes.
13. (DFX) Design for manufacturability and reliability.
14. Design the product for performance and robustness using "Design of Experiments".
15. Perform an economic (NPV) analysis of the project (revenues, costs, and profits).
16. Create the product release roadmap

" products
" Product schedules
" Product release dates

Component	Function	Potential Failure Mode	Possible Cause of Failure	Severity Scale	Possible Effects of Failure	Occurrence Scale	How easy to detect	Detection Scale	RPM	Actions Needed
Product Development	Creates the design and specifications for the products	Development schedule delay	Delays in development	5	Project timeline pushed back to accommodate delays, compressed schedule for following steps	6	Very Easy	1	30	Internal monitoring of project progress
Marketing Analysis	Defines product requirements and product lines	Lack of projected sales	Inaccurate market analysis	8	Sales forecasting incorrect, and could lead to lack of funding for further progress though the project, unrealistic product architectures and product lines	1	Very Easy	1	8	None
Transition from development to manufacturing	Moves the project from the design stage to the production stage	Production Ramp Up delays	Lack of communication or planning between design and manufacturing	5	Project Timeline pushed back to accommodate delays, compressed schedule for following steps	6	Very Easy	1	30	Involve the manufacturing team with the design of the product and process development

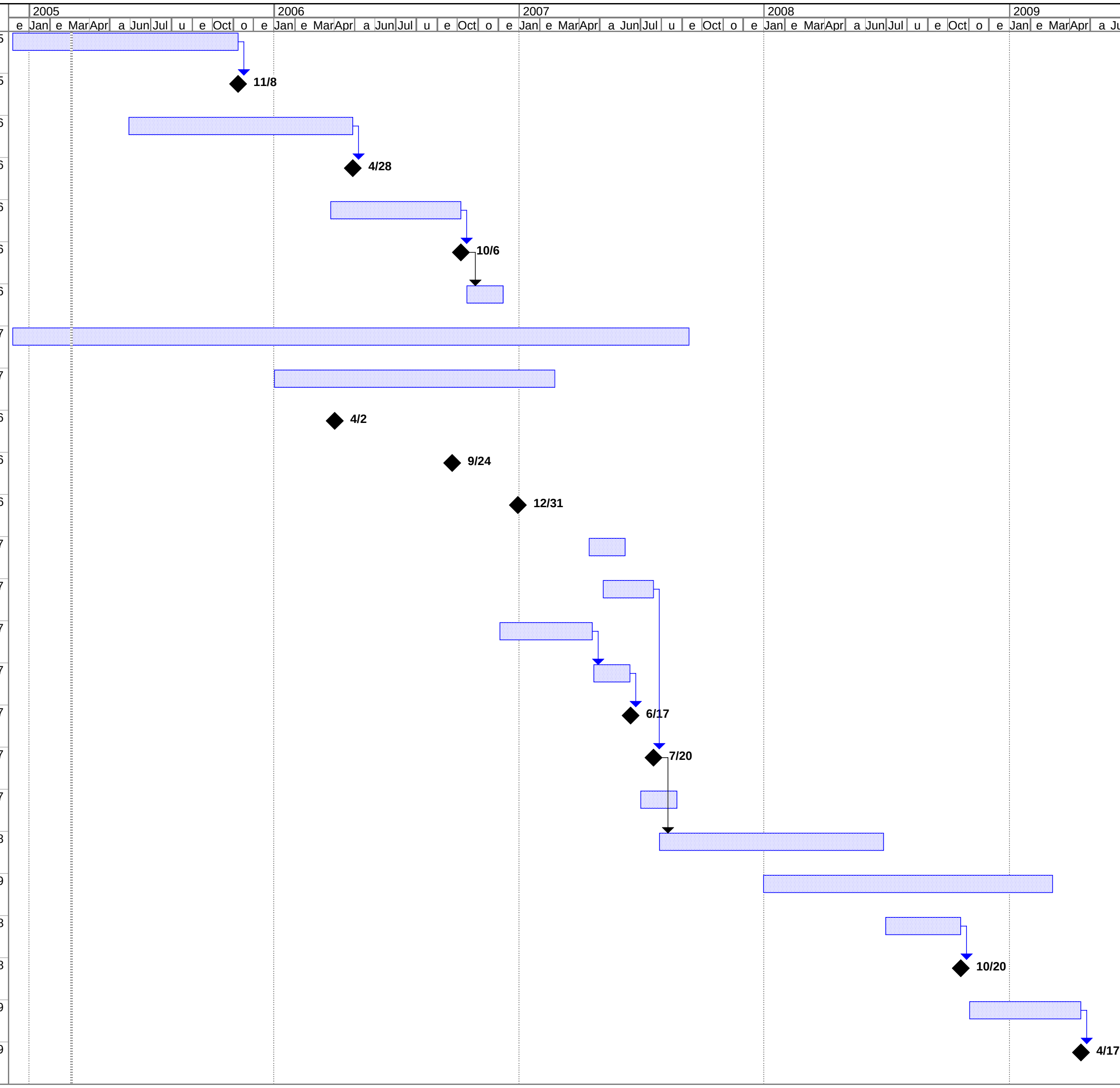
Component	Function	Potential Failure Mode	Possible Cause of Failure	S	Possible Effects of Failure	O	How easy to detect	D	RPM	Actions Needed
Internal Optics	Storing data	Percentage of Individual gates not working	heat	2	less total storage space	2	Difficult	5	20	Environmental testing procedures
"	"	"	Electrical surge	2	less total storage space	2	Difficult	5	20	Environmental testing procedures
Connection to motherboard	Communication with other devices	Intermittent data	Dust	2	Low data transfer rate	9	Very difficult	8	144	Work with motherboard
"	"	Intermittent data	Loose fit	7	Loss of data	5	Easy	2	70	Review of specifications and hands on testing with motherboard samples

Ranking	Failure Rate in % chance per day	Probability of Failure
1	0.00001%	Nearly Impossible
2	0.00010%	Remote
3	0.00100%	Unlikely
4	0.01000%	Low
5	0.10000%	Moderate
6	1-9%	High risk
7	10-49%	Serious risk
8	50-100%	Critical

Ranking	Detection Probability
1	Almost certain detection
2	Very high chance of detection
3	High chance of detection
4	Moderate chance of detection remotely
5	Somewhat unlikely to detect remotely
6	Very unlikely to detect remotely
7	Minimal chance of detection remotely
8	Impossible to detect

Ranking	Effect	Criteria: Severity of Effect
1	Very Minor	Very minor effect on performance
2	Minor	Minor effect on performance
3	Small	Small effect, does not require repair
4	Moderate	Moderate effect, requires minor repair
5	Significant	Performance degraded, single secondary function not operable
6	Major	Performance degraded, multiple secondary functions not operable
7	Serious	Performance severely degraded, system may not be operable
8	Critical	Loss of primary functions

ID		Task Name	Duration	Start	Finish
1		Fabrication Development	12 mons	Wed 12/8/04	Tue 11/8/05
2		Virtual prototype	0 days	Tue 11/8/05	Tue 11/8/05
3		Fabrication system development	12 mons	Mon 5/30/05	Fri 4/28/06
4		Physical protoype	0 days	Fri 4/28/06	Fri 4/28/06
5		Fabrication manufacturing	7 mons	Mon 3/27/06	Fri 10/6/06
6		Product Release	0 days	Fri 10/6/06	Fri 10/6/06
7		Testing and debugging	2 mons	Mon 10/16/06	Fri 12/8/06
8		Optical systems research	36 mons	Wed 12/8/04	Tue 9/11/07
9		Optical subsystems research	15 mons	Mon 1/2/06	Fri 2/23/07
10		Optical gates virtual prototype	0 days	Sun 4/2/06	Sun 4/2/06
11		Optical RAM systems virtual prot	0 days	Sun 9/24/06	Sun 9/24/06
12		Optical gates physical prototype	0 days	Sun 12/31/06	Sun 12/31/06
13		RAM physical structure	2 mons	Mon 4/16/07	Fri 6/8/07
14		Integration with current motherbo	2.75 mons	Mon 5/7/07	Fri 7/20/07
15		Optical switching chip research	5 mons	Mon 12/4/06	Fri 4/20/07
16		Optical switching chip prototyping	2 mons	Mon 4/23/07	Fri 6/15/07
17		Optical switching chip physical pr	0 days	Sun 6/17/07	Sun 6/17/07
18		Optical RAM virtual prototype	0 days	Fri 7/20/07	Fri 7/20/07
19		Fabrication calibration	2 mons	Mon 7/2/07	Fri 8/24/07
20		Optical RAM physical developme	12 mons	Mon 7/30/07	Fri 6/27/08
21		Fabrication testing for RAM	15.45 mons	Tue 1/1/08	Fri 3/6/09
22		Optical RAM and fabrication revis	4 mons	Tue 7/1/08	Mon 10/20/08
23		Optical RAM physical prototype fi	0 days	Mon 10/20/08	Mon 10/20/08
24		Optical RAM production ramp up	6 mons	Mon 11/3/08	Fri 4/17/09
25		Product release	0 days	Fri 4/17/09	Fri 4/17/09



Project: FinalprojectGANTT
Date: Fri 3/4/05

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline