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Appendix I

Seagate Technology

Seagate Technology and Disk Drive Business

Seagate is a data technology company, $7 billion revenue in 1998, providing data storage devices and database & network management software. Its core business is on rigid disk drive (a magnetic recording data storage device) which accounts for more than 80% of its revenue, the focused market segments are on desktop and hi-end drive. Seagate believes in vertical integration to leverage its competitive advantages. Strategic design centers are in US communicated via its wide-area network to strategic manufacturing sites where most of them are in Asia Pacific. Seagate owns technologies in key components such as magnetic recording head, magnetic recording-media, motor, optical channel, and other drive related components.

A strong combination of professional skills is required to develop and manufacture disk drive, including electronics engineers, mechanical engineers, computer engineers, material engineers, chemists, physicists, and a variety of scientists beside a technical management skills required to provide satisfaction to market demand. Industry's challenges are the demand for more storage capacity, faster access, smaller form factor, and lower price. During the past 40 years of disk drive history, majority of entrants to the disk drive industry has quitted due to difficulties in simultaneous managing multiple aspects of the product. There are less than 30 rigid disk drive manufacturers out of 90-100 active disk drive manufacturers where more than 200 disk drive manufacturers have been out of this business. This leaves Seagate with strong competitors; the company's major competitors are Quantum, Western digital while IBM, Fujitsu, and maxtor become competitor in some market segments. IBM is a leader in disk drive technology; they used to manufacture rigid disk drive predominantly for its own equipment, now they are interested in whole disk drive market opportunities.

Thought there is no threat by the new entrants of rigid disk drive business, but the threat is in technology development to cope with the market requirement and the intention of Big Blue, IBM, to gain market share in rigid disk drive. At present, disk drive industry is capable in technology development to accommodate market in storage capacity, access time, and price as a result of stronger survival in disk drive business. In 1996, major

disk drive companies anticipated in disk drive demand
volume increase, an extra 15-30% of manufacture capacity
increase has been planned to gain market in 1997. As a
result of recession in PC market, those companies
affected by price cut due to over-supply in disk drive.
It was a downturn of the industry as a result in closing
facilities and company restructuring worldwide. Seagate
has cut approximately 10% of its over 100,000 workforces
worldwide and spent 2-3% of its annual net sales in
restructuring.

The market is anticipated to be picking up in late 1998
due to computer demand in Y2K preparation (year 2000
effect), and Euro conversion (Europe one currency) in
January 1999.

A picture of Seagate rigid disk drive is shown in figure
1 with a picture of HGA and recording head, which is one
of the key technologies of the company. It is amazing if
we imagine the recording head, which is a 0.1-inch long
fly above disk surface at 1 micro-inch height with a
speed of 95 km/hr! An Airbus fly at top speed, one foot
above ground cannot be compared.
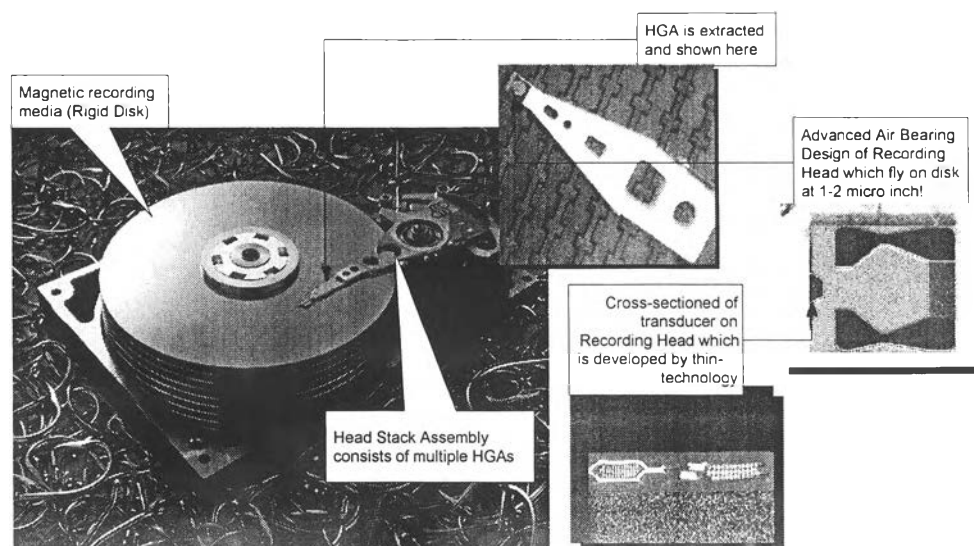
Figure I-1 Seagate Rigid Disk Drive, HGA, Air Bearing
Design, and Cross-sectioned Magnetic Recording Head

Core technology of rigid disk drive manufacture is at
recording head technology. Figure 2 shows Areal Density,
a classic measure of head technology. Seagate is behind
the technology roadmap where its own technology
demonstrates at 3.2 Gb/in2.

Rigid Disk Drives Density
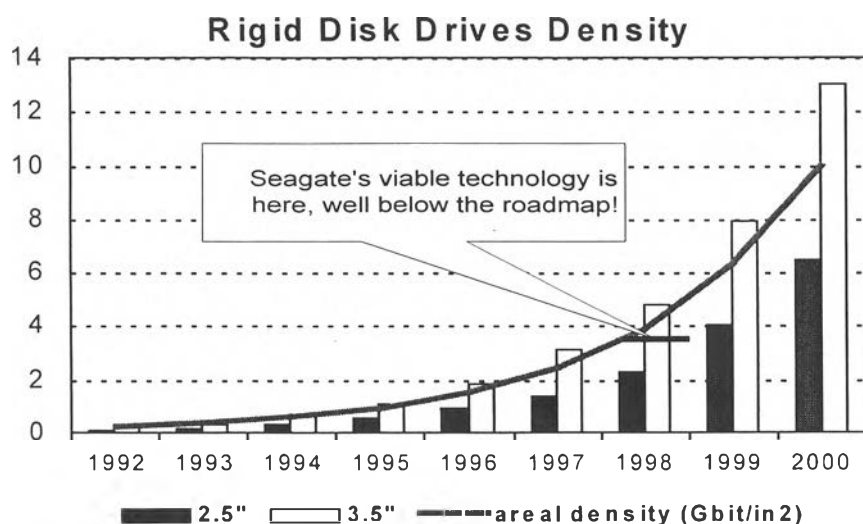
Figure I-2 Technology Roadmap of Rigid Disk Drive Industry.

In the past decade, PC users doubled their requirement in disk drive capacity every year. In late 1997, a change in desktop drive capacity requirement happened, PC buyers tend to be satisfied with the same old disk drive capacity, as long as they can by cheap PC. According to Moore's law, the price of the disk drive fall 40% every year for the same capacity. On the other hand, if the capacity of disk drive is not getting higher, then the drive price is getting 40% lower every year. With Moor's law, the industry built up so fast for the past ten years, but the law keeps on going while the industry get struggling with less profitability of shorter product life cycle. With client/server technology and Microsoft NT5.0 Operating System, total cost of a system can be reduced down by 25%.

Hence, storage capacity requirement will no longer be at desktop PC as it used to be in the past decade. Capacity requirement will be at the server instead, which it has to be a high performance and high capacity drive.

Company Profile and Environment

Seagate Technology designs, manufactures, and markets a broad line of rigid disk drives of use in computer

systems and multimedia application, such as digital video and video-on-demand. The company has a very strong financial status, as a result in software companies acquisitions during 1994-1998 and a merger with Conner, Seagate became a data technology company and world's largest independent disk drive manufacturer with the global market share of 30% in disk drive and 25% in tape drive.

Core competence of the company are data storage devices which accounts for more than 80% of its revenue, Seagate produces more than 50 disc drive models for more than 400 different OEMs and distributors with specific requirements and needs of each customer.

Seagate has manufacturing facilities in more than 10 countries and more than 37 sales office in 16 countries worldwide. The company has 4 major distribution centers in strategic locations i.e. Europe, America Atlantic, America Pacific, and Asia Pacific. The global manufacturing strategy matches very well with global marketing strategy of the company.

Changes in the external environment are very rapid in computer related industries. To avoid receiving external shock, company has to monitor the situation and be prepared proper strategies and direction for company to receive minimal impact to the profitability.

To get the whole idea of company situation and the environment, an analysis of strengths, weaknesses, threats, and opportunities (SWOT) is shown below.

Strengths

- Strong Financial, self finance with its profitability.
- Strong Manufacturing Bases, cost effective operations worldwide.
- Over 25% disk drive market share, 60% hi-end market share.
- Vertical Integration, cost competitiveness leverage.
- Multi-National Operations, logistic optimum.
- Multi Professional Skills, flexibility in operating.
- Technology Competency, product development and innovation.
- 75% OEMs, low risk in forecast and planning.
- Broadened product lines, capture market volume.
- Good Industry's Brand Image, well recognized in the industry

Weaknesses

- Too many drive design centers, poor communication and less cost effectiveness.
- Lack of Manufacturability, design used up product margin as a result in complicated manufacturing control.
- Lack of Time to Market for New Product, a failure in technological demand forecast.
- Language Barrier in Manufacturing Sites, as a result of globalization strategy.
- Ineffective Utilization of Its Software Products.
- Lack of Public Recognition in Brand Image.

Opportunities

- Optical Technology, a breakthrough of disk drives super-parametric.
- Continuous Growth in Data Storage Demand.
- Extra Growth due to Year 2000 Crisis Driven Demand.
- Growth in Requirement of Information Accessibility.
- Requirements of Optical Technology in Other Business.
- Depreciation of Asian Currency.
- Rising Unemployment in ASEAN Countries.
- Extra Growth due to Euro Currency Conversion.
- Manufacturing in East Europe and Russia.

Threats

- Fluctuation in Market Requirement.
- Shorter Product Life Cycle and Dynamic Technology.
- IBM Interested in Market Share, becomes a hi-end competitor.
- Asia Economic in Downturn, affects global demand volume.
- Asia Political Stress, India and Pakistan nuclear issue, Indonesia instability.
- Technological Partnership of IBM and Western Digital.
- Market Recovery of Maxtor and Quantum.
- Fluctuation in Exchange Rate, affecting product cost structure.
- Sub $1000 PC Requirement, driving down profit margin of disk drive.

Disk drive industry is dominated by U.S. firms and relies on overseas manufacturing but it is different than US

appliance industry. The difference is that most of the appliance companies use overseas based manufacturing as a contractor where ownership, control, and administration are not really owned by brand owner while US owners in disk drive industry own manufacturing facilities and operations overseas. The distribution of employment worldwide depends on the technology level of the tasks and national average wages beside the stability of politic and working culture in the countries. Figure 3 demonstrated the employment distribution, which need to be optimized for the most cost-effective operations, which is applied in most of the hi-tech industries.
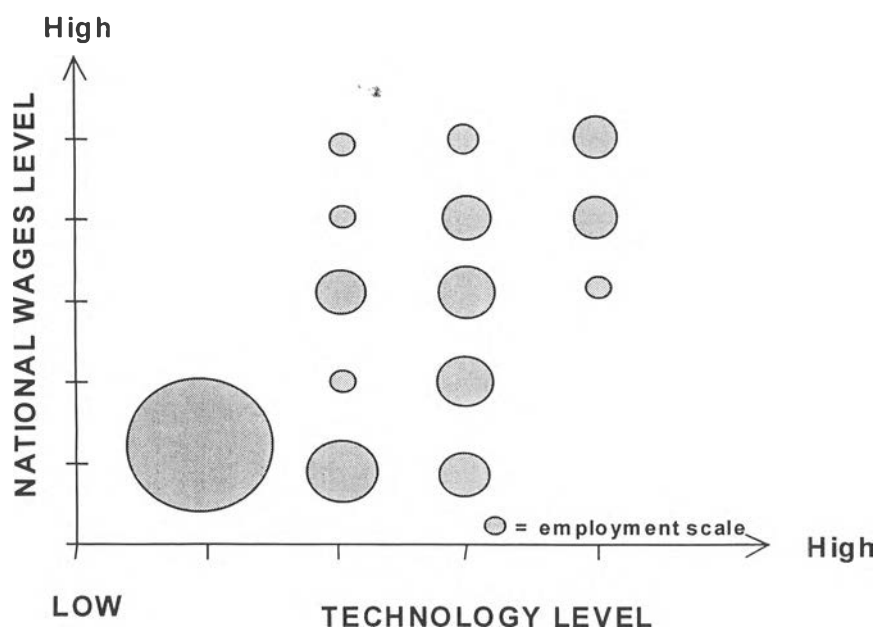
Figure I-3 Employment Distribution on National-Wages vs. Technology Level of Tasks for Global Manufacture

In disk drive industry, labor-intensive operations tend to be in the area of recording head fabrication & subassembly and drive final-assembly & test, which account for 40-45% and 20-25% of the entire disk drive manufacturing processes respectively. These major labor-intensive operations are allocated into Asia pacific countries, which has a stable politic and optimum operating cost.

Seagate pursued its strategy in globalization of manufacturing to take advantages in productivity and cost, Recording Head Group shares more than 45% of company total workforces worldwide. Imagine that from

initial recording head fabrication to inclusion in computer, one head typically cross the ocean 1-3 times and cross 4-7 international boundaries. Several processes of value chain are done in its facilities in different countries which the following factor need to be optimized to get the most benefit out of the global manufacturing.

- Logistic delay
- Unnecessary shipping costs
- Extra cost for multiple site coordination
- Tariff and non-tariff barriers
- Differences in Culture and Politic
- Risk due to currency exchange rate

Since over 60% of Seagate workforce and 15% of its market are in Asia, Political and economic issues in Asia could contribute a great deal of effects to Seagate. It might has positive impact to product cost in the short run, but it will affect the global market demand in disk drive and eventually slow down the growth of the industry. Over capacity installed and over supply driving price-cut and profit lost scenario might hit the industry twice with the pace of less than one year.

Seagate corporate mission and vision;

The mission statement of the company in year 1993 was:

'*Our mission is to be a flexible, efficient, world class manufacturing organization in the production of the highest quality, lowest cost, and time-to-market data storage products.*'

Mission statement of the company was very clear and realistic but the scope would not allow company to diversify or expand its business to other areas beside data storage product. It might be considered a minor since the 'data storage products' could be change to whatever fits to corporate vision and business opportunities. The mission statement will be translated into corporate objective, which is medium or short-term measurable target.

With a clear vision in business opportunities, leading to acquisitions of software companies during 1994-1996, Seagate turned itself to be data technology company and formulated '*Seagate Vision Statement*':

'Seagate will be the leading high quality provider of technology based products that enable computer users to access the information they want anywhere in the world.'

The statement explains at a very high level "what" Seagate will be in the futue, and corporate objectives can be listed out below:

- **Improve Time to Market for All Products**: We must strive to be the first to introduce leading products and technology to our customers.
- **Partner with Key Customers**: We must develop our key customers as partners, defining future products and integrating strategic business processes.
- **Provide Best-in-Class Manufacturing Processes**: We must attain a superior cost structure, while providing for speed and flexibility.
- **Improve Materials Management and Vendor Relationships**: Our supply chain must provide value to Seagate and our customers.
- **Technology Leadership**: We must develop leadership in key product and process technologies.
- **Employee of Choice**: We must create an environment that attracts and retains the best talent and provides for a culture that encourages knowledge growth and respect.

aOrganization throughout Seagate is able to develop goals supporting this vision and then execute those goals in order to achieve the vision. Scope of the vision is wide enough for company to formulate proper strategy. It allows company to expand its product line, which involves with computer user accessing information, for example; Internet provider, telecommunication network service, and etc.

Teparuk facility operates as a cost center, next customer is internal customer, the value of the product includes quality, delivery, and cost. What test engineering organization actually do, to facilitate the operation to deliver goals achievement, is to provide a product of **"high quality test at low cost"** to HGA manufacturing. A massive number of HGA testers (over 450 systems testing more than 20 different products), which are high precision equipment with state of the art technology, becomes major role player in the facility. Market driven hard drive industry had to trade off some product design margins to catch up needs of the market and left manufacturing with relatively low product capability. That is why 100% electrical test is required for HGA

manufacturing with its yield running around 50% on "stars" product!

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Appendix II

Test Engineering Objective Goals Setting

Organizational and Functional Goals for Q1'98 Ending

1. **Test Engineering Goals (TE)**
   - +5% ET Yield   TTI/TTS/TTD
       (same quad & volume weighted)
   - Zero Low Yield Tester >3 hours   TTC/TTD/EIS
       (ROOT)
   - 102 Test UPH   TCS/TTI
       (MR volume weighted)
   - 10% Out Z-score   TTC/TTS
       (Testers weighted by wafer)
   - $0.02 per HGA,IDL Related   NNS (Champion)
   - $0.02 per HGA, Equipment Related   NKP (Champion)

Figure II-1 Test Engineering Objective Goals

1.1 Tester Control (TTC)
Functional Mission and Goals for Q1'98 Ending

Mission:
Provide quality support to manufacturing with minimal impact due to tester.

Goals:
- 10% Out Z-score
- Zero TSPC Disciplinary issues
- Zero Low Yield Tester >3 hours
- Zero Grounding/ESD Disciplinary Issues in C/R
- 7.5% ET Downtime
- 5% Fly Downtime

Figure II-2(a) Functional Mission and Objective Goals of Tester Control (TTC)

1.2 Capacity Support (TCS)
Functional Mission and Goals for Q1'98 Ending

Mission:
Deliver high-quality tester per capacity requirement to support
flexible manufacturing with cost-effective inventory control.

Goals:
- 102 Test UPH
- 65% One Time Correlation
- ECTS Upgrade Phase-II, 100% on Ch18, Bali, NPT
- Zero Grounding/ESD Issues on Outgoing Tester
- Build/Conversion per Requirement
- $40k USD monthly saving due to single surface
- $20k USD monthly saving due to in-house board repair

Figure II-2(b) Functional Mission and Objective Goals of
Capacity Support (TCS)

1.3 Test Standards (TTS)
Functional Mission and Goals for Q1'98 Ending

Mission:
Provide effective tester acceptance test and consistent test
baseline, with continuos improvement in final calibration and tester
control procedure.

Goals:
- 10% Out Z-score
- +5% ET Yield
- 99% Effective Tester Release
- Zero Reassigned Secondary Standards
- 65% One Time Correlation

Figure II-2(c) Functional Mission and Objective Goals of
Test Standards (TTS)

1.4 Technical Development (TTD)
Functional Mission and Goals for Q1'98 Ending

Mission:
Provide effective technical consult along with cost-saving and quality related projects to support test operation.

Goals:
- ROOT effectiveness (refer TTC with features added)
- TIMS Release
- Zero Low Yield Tester >3 hours
- $50k USD Monthly Saving due to Advanced Board Repair
- Consolidated Management Information on WEB (TBD)

Figure II-2(d) Functional Mission and Objective Goals of Technical Development (TTD)

1.5 Test Implementation (TTI)
Functional Mission and Goals for Q1'98 Ending

Mission:
Provide sound implementation in test related changes including H/W, F/W, S/W and PCAs.

Goals:
- Zero Impact due to Implementation Errors
- +5% ET Yield
- 102 Test UPH
- 12 days Turn Around Time

Figure II-2(e) Functional Mission and Objective Goals of Test Implementations (TTI)

```
1.6 Engineering Information System (EIS)
Functional Mission and Goals for Q1'98 Ending

Mission:
Provide high-speed & reliable systems with informative & convenient
applications and knowledge base for productivity improvement

Goals:
•   Zero Illegal Software in TE
•   Inventory to be Complied with Y2K
•   99% Tester On-line
•   30 min. Data Transfer
•   90 min. By-shift Report Update
•   0.1% System Down-time
•   Window2Oracle
•   Application Migrated to Web
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Figure II-2(f) Functional Mission and Objective Goals of
Engineering Information System (EIS)

Biography

Roong Sivaratana was born on 24 November 1963 in Bangkok,
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