Eco-Friendly Methodology Development for SanDisk microSD line

San Jose State University, CA, U.S.A

A Project Report

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Eco-Friendly Methodology Development for SanDisk microSD line

San Jose State University, CA, U.S.A

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ABSTRACT

Eco-Friendly Methodology Development for SanDisk microSD line

Over the years we have seen paradigm shifts of many companies from being a just profitable unit to also being socially responsible units. This has led to companies invest in environmentally friendly products. Companies now focus on developing products which would be less harmful to the environment once they reach their end of life. Governments over the world also have been rolling out policies and standards to regulate the policies to save the environment. Many companies have moved fast to adapt to the new changes. Implementing these changes to a product line comes with an added cost to the company.

SanDisk is a world leader in flash memory devices. The microSD product is one of the newest product lines and finds it application in mobile devices throughout the world. With such a wide use, the product is a huge revenue generator for the company. Capacities have seen significant increase as the demand; competition and technology are driving the growth. The company plans to continue driving the growth and wish to roll out a higher capacity microSD card, which would comply with the environmental norms and demands of customers.

The project emphasizes using the product lifecycle management structure, incorporate changes, new process and tool introductions. This is to achieve a product that meets green specifications, and principles of resource conservation (reuse, reduce and recycle).
ACKNOWLEDGEMENT

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1.0 Introduction

Objective: Develop a methodology for SanDisk’s microSD product line that is eco-friendly using the concepts of design for environment, and product lifecycle management

Hypothesis: Eco-flow and methodology is fully compliant with SanDisk Green specifications, ISO 14001, EU REACH, RoHS and SanDisk EMS.

The developed methodology is submitted to the microSD product team at SanDisk who will in turn validate, implement and document the results and convey the same to the team.

SanDisk Green policy: SanDisk believes that it is a part of their corporate social responsibility to be able to promote and establish programs to meet green regulations and in turn protect the environment. We, as a consulting company will provide guidelines and suggestions to design and manufacture consumer electronics products to have the least impact on the environment.

Our company offers customers environmentally friendly lifecycle management processes. To attain this, our organization has formulated methodologies to ensure that hazardous substances are minimized throughout the lifecycle of the product and there are proper techniques used to ensure correct end of life for the product. Our organization has established these processes in compliance with worldwide green compliances as well as SanDisk’s own green policy. Our goal is to provide products and services that are environmentally safe sound throughout their lifecycles, and ensure that suppliers conduct/provide all services/material in an environmentally responsible behavior. We achieve designing green products by integrating green requirements into design, development, procurement, manufacturing, planning, lab tests, review processes to ensure international standards are met.

Worldwide, the industrial community is responding to requests to pursue environmental friendly products/packaging for consumer products. Consumer products companies like Nokia, Sony
Ericsson, Samsung, etc. are paying close attention to these regulations to establish themselves as leaders in pursuit of environmental friendly products.

These companies have published their “Green” requirements which are all slightly different from one another, therefore, there is no “one” standard definition of “Green” in the industry.

There has been a significant increase in legislations regarding substance control in electronic products recently:

- EU RoHS
- EU Packaging Directive
- China RoHS
- South Korea RoHS

SanDisk is a world leader in microSD and other flash Memory products. It is part of a number of industry-wide initiatives and standards. These include international standards as ISO 9001, ISO 14001 and the Electronic Industry Code of Conduct (EICC http://www.eicc.info). While developing a green and environmentally friendly product, the team followed the EICC code of conduct and ensured that the suppliers adhere to above code and policy. We developed procedures and processes to help develop the microSD product.

**Electronic Industry Code of Conduct:** “Corporate Social & Environmental Responsibility is the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community, environment and society at large.” [1]- (EICC Code of conduct http://www.eicc.info/EICC%20CODE.htm retrieved 02/14/2010)

The EICC consortium was created in 2004 to represent the Electronics Industry Members as a single electronics industry voice to facilitate the creation of mechanisms to demonstrate that this industry is:
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Promoting responsible business practices to improve social and environmental conditions across the global electronic supply chain.

Paving the way for a standards-based approach to monitor suppliers’ performance across several areas of corporate social responsibility, including labor practices, health, safety, ethics, and environmental protection.

Reflecting on the organizations’ commitment to leadership in the area of corporate responsibility to reduce inefficiency and make audits easier.

EICC is made up of 5 sections:

Section A: Labor and Human Rights

Section B: Health and Safety

Section C: Environment

Section D: Element of acceptable system to manage conformity to the CODE

Section E: Ethics and Governance

Our project will deal with Section C & D, based on these we have focused on suppliers and identified minimum guidelines for suppliers.

- Suppliers should:
  - Minimize environmental pollution and resource reduction
  - Obtain environmental permit & reporting of requirements
  - Control and manage hazardous chemicals and substances in products and manufacturing
  - Promote waste reduction
  - Control and manage air emissions
2.0 Product Life Cycle Management

Background:

In today’s challenging global market, innovation is the key to success. Innovations improve competitiveness and business performance. To stay ahead in the race from the competitors, a Company must capture, manage, and their human capital. A product lifecycle approach helps to address many of the needs.

The objective of adopting this approach was to provide a structured methodology to interconnect the business processes. This would enable disciplined execution through strong cross-functional collaboration throughout the total product/services lifecycle.

Product Lifecycle Management Approach:

Product lifecycle management is a set of techniques to manage the lifecycle of a product from its conception, through design and manufacturing, to service and end of life. The front end is all about testing the feasibility of ideas and exploring opportunities so that we make intelligent decisions about where we channel our scarce resources and then thoughtfully shift into more robust planning, then to execution and delivery of our service.

The Benefits of PLM

It is widely recognized that effective and complete Product Lifecycle Management (PLM) brings many benefits, and these include:

a) **High Productivity and efficiency**: Consistent, repeatable processes and practices that substantially reduce redundancy and trial-and-error, enabling the project to be more effective.

b) **Better Repeatability**: Repeatability and predictability throughout the product development lifecycle by enforcing standardized, repeatable, and dependable work methods.
c) **Reduced Cycle times/Time-to-market:** Development of dependency-driven schedules; structured, aggressive monitoring of progress toward meeting dependencies and schedules.

d) **Improved Quality:** Ability to deliver a product or service of high quality that meets customer requirements which would ultimately lead in lowering manufacturing process defects and fewer product returns.

e) **Reduced Cost:** Reduced product development costs, reduced number of product & process validation builds, minimized Manufacturing start up costs. More tightly managed programs resulting in less excess and obsolescence.

f) **Better Financial Performance:** Increased revenue from earlier introduction of products to the market.

g) **Flexibility & Agility** to respond to changing market pressures such as Globalization, technology advancement, competition etc.

2.1 **PLM Process and Structure**

The microSD Product Life cycle management is the top level business process that characterizes and coordinates all other processes, best practices, and activities; from A to Z. It consists of 6 sequential Phases and Gates (refer to Figure 1) and it provides a common model to help visualize how everything fits/works together. Each phase having unique deliverables. The PLM Structure is a high-level proposed structure and micro level deliverables and process documents, and procedures are out of the scope of this project.

The PLM process is divided into six distinct phases.

Phase 1: Concept Proposal

Phase 2: Product Definition
Phase 3: Design & Development

Phase 4: Qualification

Phase 5: Production & Sustaining

Phase 6: End of Life

Figure 1: PLM Framework

All six phases cover the entire lifecycle of the microSD Line by creating solution, development, manufacturing, service, and end of life/recycling.

This approach focuses on deliverables at the end of each phase with emphasis on implementing green engineering to develop an eco friendly product while remaining synchronized with the overall project plans and objectives.

MicroSD PLM begins with the Concept Proposal phase and continues through Product Definition, Design & Development, Qualification, and Production up to End of Life.

2.2 PLM Phases Deliverables

a) Concept Proposal Phase Key Deliverables:
At this phase the team would identify the basic document for microSD. The Preliminary MRD (Marketing Requirement Document) would list the expectation of the product. It would focus on the market; identify the need of a green product with a feasibility study.

At the end of this phase, the team would have top management approval for allocation of budget for the Project.

A formal team to work on the project would be finalized.

b) Product Definition Phase Key Deliverables:

Once the management gives a go-ahead for the project, the team would develop

- Project Schedule
- Detailed BOM with focus on
  - Green Parts
  - Green Processes
  - Govt. Regulations
  - Market requirement
  - Competitor Comparison

At the end of the phase, the team would have clear understanding of what all compliance will the product have to comply and the approach the team need to take to achieve the goal. Procedures defined later will guide the team on vendor identification, development, selection and approval to procure key components.
c) Design and Development Phase Key Deliverables:

The team will formally release Component Level BOM, AVL (Approved Vendor List) and Prototype development plan. To develop AVL procedures covered later section will focus on:

- Vendor Selection
- Product/Process Requirements with respect to green product
- Procurement policy
- Component Qualification
- Maintaining component test and Qualification database

At the end of this phase the team would verify that the product meets all Green Policy requirement and environmental norms

d) Qualification Phase Key Deliverables:

This phase would evaluate Prototype and ensure that the product meets all specifications. The deliverables would include Product and Process Qualification Report. Once the product passes the norms, all documents would then be formally released.

At the end of this phase the team would ensure that the project is within budget, the product meets the specifications, and the product is ready for Production Ramp Up.

e) Production and Sustaining Key Deliverables:

This phase would ensure formal acceptance of the product by the team and the management and the product would move to the manufacturing site.

At the end of this phase the product would move from NPI site to manufacturing site.
f) End of Life Key Deliverables:

This phase would focus on activities like recycling, reuse and disposal of the product along with serviceability and support. These policies form one of the pillars of our project. The details are covered later in the document. Besides these the team would also work on ramping down the production and closing the commercial issues.

The project ends at the end of this phase. The team would confirm End of Life/Reuse/Recycle achieved, all open issues are closed and financial performance is reviewed. The team would also compile lessons learned to serve as guidelines for future products.
3.0 Strategic Suppliers’ selection and Procurement Process

One of the projects main goals is to establish a direct relationship with a limited set of Strategic Suppliers and promote and reward high performing suppliers with growth opportunities and market share. The aim is to leverage the high volumes with these Strategic Suppliers to obtain advantageous pricing, and terms and conditions and thereby assure continuity of supply and best in class quality and overall support for the microSD program without compromising on green standards. The company needs to regulate and define the amount of hazardous materials based on various industry and governmental standards such as RoHS, China RoHS, and EU REACH. The Directive on Restriction of use of Hazardous substances in electronics equipment was adopted by the EU in 2003 and it restricts use of six hazardous materials in the manufacture of electronics.

3.1 Supplier management:

This project had the challenge of developing processes to identify and approve suppliers to maintain or improve quality and focus on green initiative for microSD project. Since most of the product development and budget focuses on the purchased goods, our goal was to competitively develop vendors. The team was aware that, purchased raw material is a target area in which had to focus to seek improved performance and cost savings if possible.

Since purchased raw material is an important lever in our endeavor to develop the green microSD Product, we needed a strategic approach to purchasing.

The Purchasing directive is closely linked to the WEEE which sets the collection, recycling and recovery of used electronics equipment. According to the RoHS directive, the maximum permissible concentration of hazardous substance cannot be more than 1000 ppm in weight of homogeneous materials.

The process consists of the following stages:

1. supplier qualification Guidelines
2. regulations on Suppliers
3. regular audits and reporting system

3.1.1 Supplier Qualification guidelines:

By making sure suppliers conform to the norms laid out, procurement of raw materials and components becomes easier. Under this plan, it becomes mandatory for suppliers to provide Certificates of compliance and provide disclosure of chemical composition of all parts being sold.

As Part of the company Green policy, all suppliers and contractors should disclose the chemical composition of all parts used in the product. Before suppliers are actually qualified, it becomes important to lay guidelines.

**Supplier Qualification Process**

This process will outline the general guidelines to follow in managing the supplier selections and classifications within Procurement.

**Procedure**

1.1. Strategic/Core Supplier Classification

1.1.1. Define Strategic Supplier and Core Supplier

**Strategic Supplier:** A supplier that provides capability to ensure environmental compliance, lowest cost, best in class terms/conditions, assurance of supply - a “predictable” supply chain with global representation.

**Core Supplier:** A supplier meeting one or more of the following criteria:

- significant industry market share in the commodity in question, and a technology leader in the commodity;
• makes up a large percentage of the SanDisk MicroSD spend
• has the potential to develop into a Strategic Supplier

1.1.2. Strategic Suppliers Provide:

• Account Management needs and support manufacturing sites.
• Quotations
• Pricing
• Terms
• Logistics
• Communication
• Contracts

Responsibilities:

Supply Chain Manager is responsible for establishing the supplier relations and to assess the supplier, to determine if the qualifications can be met to be a strategic/core supplier.

1.2. Contract Negotiations

1.2.1. NDA (Non Disclosure Agreement)
1.2.2. GBA (General Business Agreement)
1.2.3. EDI (Electronic Data Interchange)
1.2.4. SMI (Strategic Information Management)

1.3. Implement the supplier into the organization

1.3.1. Design exposure
1.3.2. Materials
1.3.3. Mfg sites
1.3.4. Packaging guidelines

1.4. Supply chain manager is responsible for the maintenance of ongoing supplier relationship.

The role and responsibilities are explained in the next section.
3.1.2 Placing regulations on the Suppliers:

Following tools would be used to regulate suppliers. These tools would enable us to focus on quality, compliance to the environmental norms and customer rating. Having the data in a database would help us in archiving and reverting back to identify issues, concerns and view historical data for the approved components.

**MDDS (Material Declaration Data Sheet)**

All suppliers should be required to provide a Material Declaration Datasheet (MDDS) stating the kind of materials the concentration of each in the homogeneous material.

Suppliers would need to provide Certificates of Compliance stating that the requirements have been met. The CoC’s should state that the suppliers comply with the green policy of the organization.

![Material Data Declaration Sheet](image)

*Figure 2: The Material Declaration sheet format for suppliers*
GEMS (Green Environment management System)

The top level processes have been defined by the Green Policy guidelines and data collection on items is done and stored in the GEMS Database.

GEMS Database consists of:

- Database for all chemical content in products
- Chemical content data of parts given from suppliers is populated into GEMS
- Capable of generating product level MDDS
- Enable to flag any controlled substances in the BOM tree
The GEM database will be a custom database that tracks the percentage of all the materials during the lifecycle of the product. The GEMS Database has capabilities to provide values according to compliance levels as shown below:

![Figure 4: Certificate of Compliance to the RoHS Directive from subcontractors and suppliers](image)

The product would require all subcontractors and suppliers to provide a C of C to the RoHS directive for all products supplied.

**Regular auditing of product families for RoHS Compliance**

Periodic chemical analysis on samples taken from product families will be done to ensure that RoHS compliance is being maintained.

RoHS substance monitoring will be initiated as a part of the ORT (Ongoing Reliability Test) program.

**Verification of New Products**

The microSD needs to comply with RoHS standards.

The compliance of new products to the RoHS directive will be reviewed before release.

Lab test reports from third party certified labs should be available.
MDSS (Material Decision Support System)

MDSS is a global data warehouse that supports automatic data collection from ERP systems which we plan to use for vendor management. The data elements in the warehouse are presented in the context of Material, Inventory, and Procurement Management.

MDSS as a tool would clean, structure the data and ensure that data has the required quality, and delivered in a managed environment, through either on-demand reporting or through information push to users or other systems internal or external to the company. This tool will be used to ensure that the component comply with the environmental standards required for the product.

Features

- Delivers global procurement data and reports for analysis
- Provides selected aggregated data back to the local ERP systems.
- Provides tools, systems and visibility to measure global excess inventory and leverage global price.
- Supports powerful analysis with raw and calculated data, trend and user customized data

Benefits as a Tool

- A standardized tool to manage data
- A central repository for global parameters and dimensions
- Supports programs to manage Key Performance indicators to ensure maximum profitability

Benefits for Users

- Ability to create global scorecards and dashboards
- Reconciliation of local reports
- Creates transparency across all facilities to achieve global coordination
- Ability to review, analyze, and summarize global business activities
• Ability to make strategic decisions based on facts

**Purpose:** The primary users of MDSS will be the Procurement and the Materials teams. MDSS can be used to analyze the site information, along with that from other sites, escalate the shortages issues in the MDSS Shortages Escalation Tool, rate suppliers, and generate a variety of reports and evaluation metrics.

• **Inventory Redistribution Program (IRP):** As a buyer, there may be times when one needs to procure materials from another site’s excesses, or dispose excess materials to another site that has requirements for it. MDSS reports can be used to check to which sites might sell or from which sites one may buy materials.

• **Shortages Escalation:** If a supplier is unable to commit to a delivery or is late with a shipment, and the parts are urgently needed, one can escalate the situation to his/her supervisor using the Shortages Escalation Tool.

• **Suppliers Rating System (SRS):** Suppliers are routinely rated on various metrics, for example, delivery performance, quality, and service. The Suppliers Rating System (SRS) within MDSS is used to set these ratings.

• **Reports and Metrics Generation:** A variety of reports can be generated from MDSS, for example, Purchase Price Variance (PPV) and Global Price Reports, which can help you on a daily basis.

Once MDSS is used we will set following criteria for vendor evaluation. All vendors/suppliers must be rated by that site. The rating would be based on five rating criteria with each having different weight age points:

1. Quality Performance      Max. 25 points
2. Delivery Performance     Max. 15 points
3. SMI/CRP                  Max. 15 points
4. Cost Competitiveness    Max. 30 points
5. Service Performance  Max. 15 points

Total available  Max. 100 points

Overall Cumulative Scoring: Maximum Score would be 100 points. The overall supplier performance status would be determined as follows:

<table>
<thead>
<tr>
<th>Status</th>
<th>Rating</th>
<th>Definition</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>&gt;80 Points</td>
<td>fully approved performance status, and condition to become a preferred supplier.</td>
<td>Approved</td>
</tr>
<tr>
<td>Yellow</td>
<td>60 points &lt; 80</td>
<td>Supplier must provide a documented improvement plan</td>
<td>Needs Improvement</td>
</tr>
<tr>
<td>Red</td>
<td>&lt;60 Points</td>
<td>Supplier must provide documented detailed corrective action Plan. Business will be diverted from status red supplier whenever possible</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Table 1: Supplier Rating Score Criteria
3.2 Process Flows:

Following are the process flows for data collection for existing parts and new Parts:

![Data Collection and Data management Process](image)

Figure 5: Process Flow – Data Collection and Data Management
Data Collection and data management process for new components

Once the environmental compliance of an existing component is available or a new component is added to the AVL, we would need details from MDDS and Lab Test to qualify the component.
Following is the process for conducting the Lab test for the component to qualify it.
Open Lab Test Report Flow (for parts and products)

Any component which is in the AVL should pass through a compliance process before it is actually used in the product. The following Process flow describes the steps needed to be taken in case of a noncompliance if a component.

Figure 8: Process Flow – Open Lab Test Report
Figure 9: Process Flow – Non Compliance (New and Old Components)
3.3 Conducting Regular Audits on Suppliers:
By conducting regular supplier audits, it will be ensured that the Supplier compliance is maintained and Integrity of the product is not compromised.

The Audits could either be conducted by either SanDisk employees and or external auditors. A methodology for supplier disqualification can also be formulated if the supplier is found not complying with the given regulations.

By conducting audits, it would also ensure there is intense collaboration between the suppliers and the manufacturers and any changes can easily be transferred to the supplier. This provides a tool to assess potential Supplier’s product and management systems to meet SanDisk business needs and requirements.

**Scope of suppliers’ survey:** Applies to potential Direct Material Suppliers, Contract Manufacturers, ODM, Fulfillment Centers, and, at the discretion of Procurement management, to Capital Equipment and Non production suppliers that provide key materials, equipment or services to SanDisk, and to those SanDisk personnel involved in supplier management activities.

**Roles and Responsibilities:**

Primary Owner Department: Procurement

Review, Approval and Implementation Departments: Procurement, Supplier Quality Engineering, IT Security and Brand Protection (Physical Security)

**Requirements**

Supplier Quality shall maintain the checklists to assure requirements are clearly defined.

Procurement shall distribute the Supplier Survey and provide the appropriate checklists per Table 1 Supplier Survey Requirements by Commodity Type.
Procurement shall evaluate General Business Information, ensure checklists are complete and route survey and supporting documentation.

For CM, DM, ODM and Fulfillment Centers refer to Flow Chart.

Procurement shall initiate routing of survey and attachments in Agile.

The SQE shall complete the “vendor rating” and provide summary score and justification.

Actions shall be initiated to resolve all scores that are not considered acceptable by reviewers.

Procurement and SQE shall log and track all actions to closure.

Supplier Management Team shall initiate an on-site audit to validate supplier survey responses and issues, supplier being moved to “RISK” status must have an onsite audit to close on “RISK” items.

For Non-production and capital equipment suppliers Procurement shall evaluate the General Business Information and forward additional checklists.

All line items designated as “must haves” on the Supplier Survey must be completed and approved by the required reviewers before production parts from a new manufacturer may have their qualified status changed to ACT on Agile.

**Business Management System (BMS) Records**

<table>
<thead>
<tr>
<th>BMS Record Name</th>
<th>Final Storage Location</th>
<th>Filing Index Final Storage</th>
<th>Minimum Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier Survey</td>
<td>Agile for CM, ODM, DM and Fulfillment Centers Sprocket for non-production suppliers</td>
<td>Supplier Name</td>
<td>3 years</td>
</tr>
</tbody>
</table>
## Table 2: Supplier Survey Requirements by Supplier / Commodity Type

<table>
<thead>
<tr>
<th>Supplier / Commodity Type</th>
<th>BMS</th>
<th>EMS</th>
<th>CSR</th>
<th>Physical Security / Brand Protection</th>
<th>IT Security ISO 27001 / ISO 27002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Owner</td>
<td>SQE</td>
<td>SQE</td>
<td>SQE</td>
<td>Brand Protection</td>
<td>IT / Information Security</td>
</tr>
<tr>
<td>CM</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Test</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>ODM</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Fulfillment Centers</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Foundry (memory &amp; controllers)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Direct Production Material Suppliers (for SDSS, and critical suppliers - substrates, labels, lids)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>At discretion of SanDisk Brand Protection, Risk dependent; (e.g. Artwork, Molds, Product specifications)</td>
<td></td>
</tr>
<tr>
<td>Capital Equipment Suppliers</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Production Suppliers (e.g. key engineering services, tooling)</td>
<td>At discretion of SanDisk Brand Protection, Risk dependent</td>
<td>At discretion of SanDisk IT Security</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ACTIVITIES/Responsibilities**

**PROCEDURE**

**INSTRUCTIONS**

**REQUEST FOR NEW MANUFACTURER APPROVAL**

**REQUEST SUPPLIER TO COMPLETE SURVEY / CHECKLISTS**

**CHECKLISTS COMPLETE, GENERAL INFO OK?**

**YES**

**INITIATE NMA REQUEST TO ROUTE SUPPLIER SURVEY IN AGILE FOR APPROVAL**

**SUPPLIER SURVEY RESPONSES OK**

**NO**

**PROCUREMENT WITH SUPPORT OF SQE REQUEST ACTION FROM SUPPLIER, MAY PERFORM ONSITE AUDIT AND TRACK ACTIONS TO CLOSURE**

**APPROVE SUPPLIER SURVEY**

**ADD SUPPLIER TO NMA IN AGILE**

**NOTIFY SURVEY IS APPROVED by AGILE**

**SUPPLIER SURVEY APPROVED**

**LAUNCH SURVEY**
- Procurement
- Packaging Engineering
- Process Engineering
- Test / Product Engineering
- Product Management

**ROUTE SUPPLIER SURVEY**
- Procurement / Commodity Manager
- Purchasing Coordinator
- SQE
- Document Control

**Instruction:**
- Usually Engineering or Business Unit initiates request to Procurement for Supplier Survey

**Instruction:**
- Procurement sends Supplier Survey (04-02-00003) to Supplier and monitors return receipt. For CM, ODM, Fulfillment Suppliers include the IT Security checklists. Refer to Table 1.

**Instruction:**
- Procurement / Commodity Manager reviews General Business information if not OK notifies Requestor and Supplier and does not route survey.

**Instruction:**
- Procurement Coordinator initiates “NMA Request” in Agile, refer to 07-02-00041 NMA Process. Routing list in maintained in CCB Matrix on Sprocket / Document Control

**Instruction:**
- Document Control Analyst routes, Agile send Notification of approval to Approvers. (Released status)

**Instruction:**
- Document Control follows NMA Process 07-02-00041 to add supplier to NMA list

**Instruction:**
- Document Control notifies Purchasing Coordinator and CCB list

**Instruction:**
- Purchasing Coordinator updates Approved Manufacturing list in Agile refer to 07-02-00041

---

**Figure 10: Process Flow – Supplier Survey Approval**
Supplier Qualification Criteria:

a) If a critical element (RED) is a ‘0’ then SanDisk can’t entertain this supplier, supplier will need to establish these critical processes for any engagement with SanDisk.

b) If a critical element is ‘1’ then the supplier can be designated at ‘RISK’ status and immediate actions must be initiated to improve the area with rating “1”. SQE may initiate CAPA to track actions internally, refer to CAPA procedure 67-01-00004. Work can be initiated with the supplier while it is at ‘RISK’ status after written approvals from the Director of Procurement & Director of Quality; risk is for limited quantity and time period. Refer to Contract Manufacturer Risk Buy Procedure 04-01-00001.

NMA will remain at open status until the ‘RISK’ status is removed.

c) If a non-critical element is ‘0’ or ‘1’ then an improvement plan needs to be initiated by SQE team and the supplier can be designated ‘ACT’ with improvement actions in the QMS system.

Security / Brand Protection Criteria:

- These requirements will be reviewed by Security team.
- Security team will be approvers on each NMA request.
- Security related improvement plans will be coordinated by Security team.

Supplier categories:

- **Strategic suppliers** are the primary suppliers that we want to do business with and have met all of the above criteria for that status.

- **Tactical suppliers** are suppliers that will be willing to work toward meeting the Strategic criteria or are suppliers we have to do business with because of their print position. Eventually the vast majority of our suppliers will fall into one of these two categories.
Criteria for a strategic supplier:

- Global manufacturing presence and logistics capabilities (inventory management/liability)
- Global pricing capabilities with regional flexibility
- Strong technical capabilities and dedicated engineering support
- Consistent and excellent quality
- Able to provide a continuity of supply to MicroSD
- Willingness to provide priority allocation during times of short supply
- Willingness to provide aggressive pricing and Terms & Conditions
- Flexible in handling demand changes
- Strong alignment in corporate green policy and commitment to green technology

The PSL (Preferred Supplier List):

The PSL is determined by the suppliers in the Strategic list first, and then the Tactical list second if there is no alternative. Not all Strategic suppliers will necessarily be on the PSL list. Selections are Segment dependant.

ABC classification:

ABC classification refers to a hierarchy for classifying parts based on spend, which is cost times volume.

Usually 80% of the spend value is classified as A items, 15% as B items and 5% as C items. Due to their higher cost there must be the tightest inventory control given to the A items.

ABC Classifications provide the opportunity for every site to choose what Forecast percentage they wish to classify as A, B or C items. This calculation can be also run per Customer or per entire Site.

RoHS banned substances: RoHS refers to Restriction of the Use of certain Hazardous Substances in Electrical and Electronic Equipment
3.4 Procurement of RoHS compliant materials

Procurement policy and procedures require all suppliers to be RoHS compliant for microSD products. In order to determine suppliers candidacy for the Approved Supplier List, green policy requires suppliers to provide information on their EMS (Environmental Management System). All suppliers will need to send a materials declaration data sheet (MDDS) for every item supplied. Suppliers are required to be are certified for ISO14001. Products are compliant with all applicable regulations. Product design guidelines for creating new products contain the following:

- Reduction of transport-related energy consumption by reducing product volume and weight
- Improvement of product and packaging design
- Removal of banned and restricted substances from products
- Designing with final product disposal in mind.

RoHS compliance specifications:

The following are the content information that is required to do laboratory analysis for each microSD component:

<table>
<thead>
<tr>
<th>Banned Chemicals</th>
<th>RoHS Max Concentration Value in ppm</th>
<th>SanDisk Analysis values in ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium (Cd)</td>
<td>100</td>
<td>&lt;7</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>1000</td>
<td>&lt;31</td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>1000</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Hexavalent Chromium (Cr+6)</td>
<td>1000</td>
<td>&lt;2</td>
</tr>
<tr>
<td>PBB(Mono Through Deca)</td>
<td>1000</td>
<td>&lt;100</td>
</tr>
<tr>
<td>PBDE (Mono Through Deca)</td>
<td>1000</td>
<td>&lt;100</td>
</tr>
</tbody>
</table>

(Data based on SanDisk RoHS Declaration)
Incoming Inspection Procedure

This document describes the activities to perform incoming inspection and above RoHS compliance specification.

Responsibilities

SQE: Establish product Inspection Instruction, handle the issue of supplier product quality and hold the corrective and preventive action.

IQC Inspector: According to Inspection Instruction to inspect the incoming material and do the record, maintain the related worksheets and equipments.

Operation procedure

- HUB receiving person submits the request for inspection notice.
- IQC Leader receives the request and logs it in Log Sheet and indexes it with an IIR (Incoming Inspection Record) cross-reference number.
- IQC Leader will allocate inspector to inspect according to the principle of First In First Out. Deviation request for out of turn inspection should be approved by the SCM.
- The inspector will find the inspection level and sample size from the part inspection instruction and fill them in the IIR (Incoming Inspection Record), and draw sample units from the lot/batch. In doing so, the units from each part of the lot/batch shall be selected at random.
- The inspector should review the incoming inspection history record and material management list so as to get to know and pay special attention to the problem occurred with former defect or non-conformity.
- Special focus and attention should be given on environmental specs and COCs like the RoHS relevant test report from supplier.
- The inspector needs to check test method which should be written into report if in accordance with below listed test method.
When the test method not in accordance with below listed test method, this material should be rejected and sent back to supplier for retest.

<table>
<thead>
<tr>
<th>Material analyzed</th>
<th>Analytical method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pb, Cd, (Hg if cold vapor method used)</td>
<td>Atomic absorption spectroscopy (AAS)</td>
</tr>
<tr>
<td>Pb, Cd</td>
<td>Inductively coupled plasma spectroscopy (ICP)</td>
</tr>
<tr>
<td>Chromium VI</td>
<td>Ultraviolet/Visible spectroscopy</td>
</tr>
<tr>
<td>Pb, Cd, Hg compounds, Br, Cr</td>
<td>Energy dispersive X-ray analysis with a scanning electron microscope (SEM/EDX)</td>
</tr>
<tr>
<td>Pb, Cd, Hg</td>
<td>Spark emission and DC arc emission spectroscopy</td>
</tr>
<tr>
<td>Pb, Cd, Hg, Br, Cr</td>
<td>Glow discharge optical emission spectroscopy</td>
</tr>
<tr>
<td>Pb, Cd, Hg and CrVI</td>
<td>Paleography</td>
</tr>
<tr>
<td>Brominates flame retardants</td>
<td>High performance liquid chromatography (HPLC)</td>
</tr>
<tr>
<td>Brominated flame retardants</td>
<td>Ion chromatography</td>
</tr>
<tr>
<td>Brominated flame retardants</td>
<td>Gas chromatography mass spectroscopy (GCMS)</td>
</tr>
<tr>
<td>Pb, Cd, Hg, Br, Cr</td>
<td>Energy dispersive X-ray fluorescence analysis (ED-XRFA)</td>
</tr>
<tr>
<td>Pb, Cd, Hg, Br, Cr</td>
<td>Wavelength Dispersive X-ray fluorescence analysis (WD-XRFA)</td>
</tr>
<tr>
<td>Brominated flame retardants</td>
<td>Fourier transform infrared (FTIR) spectroscopy</td>
</tr>
</tbody>
</table>

**Table 3: Process Flow – RoHS Substance Analytical Method**

- The inspector shall verify and check the sample units as per the clauses specified in Inspection Instruction one by one.
- The inspector should fill the inspection information and findings in IIR (Incoming Inspection Record), and make a determination Pass or Reject to the inspected lot/batch contrasting with AQL.
The inspector should mark the defective units with a red arrow and restore the sample units to the original package after inspection activity is completed. The package opened for sampling shall be marked with a little label.

Disposition for Pass lot.

i. The inspector shall hand the IIR (Incoming Inspection Record) to IQC leader for review.
ii. The inspector will stamp “PASS” on the inspection sheet and/or sign on it, and the goods packaging need to be stamped with “PASS” on as well.
iii. The inspector return the sample and the Inspection Sheet back to HUB, and HUB receiving clerk should verify the sample quantity and receive it with signature.

Disposition for Reject lot.

i. If the inspected lot/batch is rejected, the defective units and the IIR shall be submitted to MQA Engineer/IQC technician or above for verification and he/she need sign the IIR if it is confirmed.
ii. The inspector should put the Reject lot samples into “MRB Area” or put an “MRB” tag board on the lot/batch.
iii. IQC leader/clerk should inform material planner about the reject information, so material planner shall call MRB meeting to review the reject lot and make the final disposition at MRB meeting.
iv. The inspector returns the samples and IIR back to receiving area and HUB receiving clerk should verify the quantity of the samples and receive it with signature by return.
v. The inspector should identify the IIR & the packages of the lot/ batch with corresponding MRB label/stamp, such as RTV, UAI, Sort, Rework etc, as per MRB final disposition determination.

The defect samples should be returned to suppliers/vendors, if the inspected lot is accepted.
The inspector should record the incoming inspection data into Incoming Quality History Record or IQC database.

All IIR must be handed to IQC leader for filing.

The inspector must put back all apparatus and/or tools and documentation to their original places.

The responsible MQA Engineer shall determine whether normal or tightened inspection shall be used on re-inspection and whether re-inspection shall include all types or classes of nonconformities or the particular types or classes of nonconformities that caused initial rejection.

Record

All quality records mentioned in this work instruction will be kept in IQC for one year at least.
4.0 Roles and Responsibilities for Material Procurement:

Based on the endeavor of the project to develop an environmentally friendly product, we have focused on the role of the Project team and defined key roles and their responsibilities. The team would ensure that procurement is in sync with the procurement process discussed later. The team would work for the success of the project.

**Master Production Planner / Master Scheduler:**

Master scheduler is responsible for creating the weekly production plan and ensures correct execution. He/she is also responsible for delivering a new production plan in case of major shortages or machines failures which may cause impact on direct labor or customer deliveries. Work closely with program management team, to assure direct labor capacity and utilization. Master scheduler is responsible for total site capacity & resource mgmt. Critical resource allocations are made based on his input with intent of optimizing their availability.

**Planner:**

Materials planner is responsible to analyze the demand and assure ERP system is updated with latest information for the whole team (buyers and logistics). He is also responsible for executing MPS/MRP routine and assures output of forecast demand, purchase requisitions and reschedule/cancellation messages, guiding buyers to focus on important parts for new purchases or any reschedule/cancellations. Materials planner is also responsible for inventory risk management which will include Excess & Obsolete mgmt, ECO Mgmt, MRB Monitoring, RMA & Rework mgmt, work order variances & closures and OTD mgmt (This is measured in 3 metrics, OTD to commit, OTD to request, OTD to MPS). The Planner also provides analysis and shortage analysis to expedite materials with buyers and traffic department, including activities like waterfall analysis.
Planning Manager:

The planning manager will play the role as an escalation point of all issues related to planning and were not executed correctly. The Planning Manager is also responsible for the training, educational & professional development for all of the team members.

Production Control:

The production control will work closely with the planner to ensure daily / weekly execution to the delivery plan set by the planner, (both for normal production & RMA / RW). The production control will also be responsible for all aspects of materials risk mgmt related to the materials in WIP (work in process). This will involve close monitoring of scrap activities, attrition activities, cycle count reconciliation; back flush exceptions, regarding identification activities and inventory adjustments.

Buyer:

The Buyer, in conjunction with the Purchasing / Planning team, will be responsible for sourcing and purchasing materials to support the day to day operational needs, ensure there is supply to meet the customers demand, will meet corporate inventory cycle targets and also maintain inventory at target level. The Buyer will be responsible for establishing and maintaining good customer relations with the supplier base and will work closely with the team to drive continuous cost reduction (anything that can be captured during the daily routine), delivering maximum advantage to the business and its customers. The buyer will be responsible for making supplier understand the need for compliance to certain environmental norms. The buyer will be responsible on making sure the supplier delivers the product with proper testing and MDDS data.
Supply Chain manager:

The SCM is responsible for participating in procurement activities when called upon. Their assistance will be needed with escalations to suppliers concerning environmental compliance, pricing, and quality issues. The SCMs are responsible for the fair and ethical treatment of suppliers.

Supplier Quality Engineer (SQE):

The Supplier/Vendor QA Engineer is responsible for implementing environmental test practices and criteria, continuous quality improvement programs with the suppliers.

Purchasing Manager:

The Purchasing Manager works closely with the purchasing team. Purchasing manager will manage the organization in order to reach and maintain purchasing objectives, follow purchasing policy and procedures.
5.0 Engineering Management System

In the current scenario, 85-95% of electronic goods are being sent to landfills. The National Renewable Energy Laboratory assessed that approximately 35 billion lbs of waste/plastics will end up in landfill every year and unfortunately only 1.5% of plastic waste is reused/recycled.

Currently project proposes to have the company (E.g. SanDisk) operate recycling of its products through manufacturers. The cost of recycling products is incorporated into the product market price. The development plan would effectively provide End-of-Life cycle procedures for its products through various companies (Trifiro, Ferruccio 2005). These companies would offer take back programs that would provide incentives to handle obsolete electronic products/equipments after their usage. The take back program initiatives are discounted prices for new products for returning old and no longer in use products, product buy back, free drop off’s for recycling, etc.

The electronics recycling industry is now a stable industry that operates mostly through manufacturers. Initiatives are being taken by electronic companies to include the cost of recycling products into the product market price. Companies are now proactively working on developing effective End of life cycle procedures for their products by coming up with various company take back programs which give consumers more incentive to effectively handle obsolete electronic equipment after usage. Initiatives such as product buy back, discounted prices for new products upon turning in old and obsolete products and the concept of free drop off’s for recycling have motivated customers to properly dispose old and obsolete electronic equipment. It has been found that most electronic equipment contains hazardous waste such as cadmium, lead, mercury and PVC (Poly Vinyl Chloride). Many countries are now proactively participating in combating the e-waste problem. Europe has formed the WEEE (Waste Electrical and Electronic Equipment Directive) which specifies laws for manufacturers in collecting and recycling electronic waste. This directive is enforced in conjunction with other directives such as the RoHS and the EU REACH. The essence of these directives is to enforce manufacturers to develop processes and initiatives to handle electronic waste (Simpson, Mary Anne 2008).
5.1 Environmental Engineering Solutions

Reusable engineering methods such as modular design is the right technique adopted that can be combined into subsequent designs where portions of earlier designs turn into basis of new designs (Guidance, Fabio & Risitano, Antonio, Et al 2006). In terms of Computer Aided Design, simply copy previous design details and transfer them to other drawings/designs. The main benefits of reuse and modular design are better reliability from proven parts and designs, simpler supply chains and more flexible operations and less engineering effort.

Design the products such a way that it reduces manufacturing process defects, reduce product development costs, minimized manufacturing start up costs, cut production throughput times, reduce inventories, cut in half errors reaching the customer, cut in half job-related injuries, etc.

Environmentally Conscious Design and Manufacturing (ECDM): The approach is proactive. The objective of this approach is to reduce environmental impacts in the early stages of product and processes design (Martin, Raymond 1998). ECDM is categorized into two steps: DFE (Design for Environment) and EMS (Environmental Management System). The below figure illustrates entire product life cycle and recycle process.

DFE approach is proactively that focuses on upgrade and extends product life by preventing environmental impacts. It basically is a green product design.

Environmental Management System (EMS) is remedial and emphasizing on demanufacturing process.
Figure 11: Process Flow - Production & EOL process
As you could notice in the figure, in production, manufacturing division purchases raw materials and/or new components from outside vendors/suppliers, and then manufactures the products and distributes those products for sale to customers.

Production division consists of Remanufacturing and recovery of material where as disposal division is for reuse and disposal to environment (Ferris, Tad & Zhang, Hongjun 2007).

1. Remanufacturing or refurbishing is recycling the returned product (at the end of its life) for producing the same type of products at manufacturing plant.
2. Recovery is recyclable products for producing different type of products at the plant. It is designed after converting the product into raw material or using components again.
3. Reuse is using the same products again to increase product’s life.
4. Rest is waste that needs to be discarded.

The process begins when the customer buys one of microSD product and uses it. The user takes it back to the retailer or a favorite recycling center. The company pays retailer a small amount for sending it to our authorized recycling center.

Upon collection of products, parts are segregated and color coded to allow easy sorting. Some parts can also be and reused. In that respect, it is a closed loop process of reusability. During the process of recycling, metals are required to be separated from plastic and all material is required to go through metal detectors prior to molding operation.

Some of the sorted pieces are reground into material. The ultimate goal is to ensure that 85% of the microSD material is actually reused/ recycled.

5.2 Company compliance methods:
The company would be responsible for RoHS and WEEE compliance. If products contain more than specified allowable levels of cadmium, mercury, polybrominated biphenyl (PBB), hexavalent
chromium, polybrominated Diphenyl Ethers (PBDEs), RoHS directive is to ban that product from placing it in the market. RoHS works with WEEE to reduce the amount of hazardous materials or chemicals used in manufacturing of the product. SanDisk will have to make sure that manufacturers supply the parts, products and components in compliance with RoHS in order to sell and distribute in the market.

SanDisk has partnered with various companies to protecting the environment. It promotes recycling and prevents pollution by containing waste. Company would take-back recycle programs of its own for free on old equipment with a purchase of a new SanDisk product. It will work with various recycle vendors that have high environmental standards for protecting our planet and complying state and federal environmental laws (Trifiro, Ferruccio 2005).

It partners with BestBuy, Costco and Samsung to dispose old products safely. Many of the old, broken, unused and obsolete flash products are well e-carnated. Consumers can bring such products to BestBuy or Costco so that they are recycled safely and properly. This service is being offered for free all consumers and employees. BestBuy follows all recycling standards and partners with reputed and qualified recycling companies to dispose, recycle, remanufacture, and reuse SanDisk products.

If consumer chooses a free recycling option at the time of purchasing a microSD, SanDisk would take away the old equipment regardless of retailer. The company partners with various charities to help economically poor people. Consumers can donate products to these charities via website.

5.3 Take back programs:

The ultimate aim of take back service is to ensure the well being and health of customers, users, employees and community where microSD are produced and disposed. The OEMs, brand owners and retailers take complete responsibility for the reuse and recycle of their products.
Eco-Friendly Methodology Development for SanDisk microSD line

San Jose State University, CA, U.S.A

The developed guidelines would work as brand owner’s policy to promote the consumption of all electronic products waste and curb toxic electronic waste.

SanDisk’s take back program involves pick up, reuse, transportation, donation and recycling the used and/or obsolete products. All received microSD products will be evaluated for reuse. If the products are functionally right, they will be donated to non-profit organizations and schools.

The products that can’t be reused will be recycled to maximize the recovery of material. The recovery will take place at OEM site. SanDisk would develop a unique policy and process to evaluate all the returned equipment, extract usable parts and recycle the rest. The demanufacturing process includes remanufacturing and recovery of material. The demanufacturing unit consists of state-of-art shredder to grind electronic equipment into small pieces. A sequence of magnets and separators divide the material into usable and non-usable metals. Below are some of the guidelines offered to consumers during purchase of electronic products:

- Do not dispose old microSD products in the trash: Do not throw used products in the garbage. These products contain toxics that don’t deserve to enter the landfill.
- You can donate them for reuse: If the products are working, donate items for reuse. There are many organizations in every local area to take used products and give them to the needy. These organizations are non-profits.
- If the product is broken or very old to donate, please recycle them. You could choose recycler at local area. Make sure that recycler doesn’t export the product to developing countries where they end up in landfills.

Have a company introduce new policy to ban all e-waste exports. Unused products would not go from developed nations and developing nations.
OEM’s free recycle programs:

- Buy new SD product and select free recycle option at the time of purchase: Trust in buy and trust in dispose: Win-win situation
- In Store take back – users can drop off for recycling SD products at any retail store for free. Partners with BestBuy, Costco, Fry’s, etc.
- Online Tech Trade-in Program: buy with select free cycle option, will receive gift card from store or SanDisk. Exchange not broken and used microSD with a gift card.
- Recycling kiosks: Company take back program - drop off used, unwanted products at Company and retailers.
- Every US company location and retailers would have free kiosks, just inside the door, to drop off used, broken or obsolete microSD products.
- Mail them back for free and company will take them to recyclers.
- Partners with 1-800-RECYCLING or www.1800recycling.com. If customer can’t decide what to with used or broke microSD products, call toll free number for recommendations.

In addition to the above programs, SanDisk would have the following links for Recycling:

- Free recycling anytime:

  Recycle used/unwanted microSD products for free. Additionally, buy a new SanDisk product and select free recycling option during the purchase and company will recycle used/old products absolutely for free.

- SanDisk will partner with e-steward or non-profit reputed foundation to make available the reused products for economically disadvantaged and disabled kids. Customers can directly donate them with free UPS service.
- SanDisk will promote asking consumers to consider a refurbished product to reduce impact on environment. It will save money and provides perfect product to your current needs.
5.4 Design for environmental packaging:

The goal for environmental packaging is making packaging professionals understand environmental impacts of packaging methods and material used. The methodology would improve the environmental qualities of packaging and processes and simultaneously meet business goals.

The toxic materials need to be phased out and avoid using ozone-depleting chemicals in packaging. The raw material used for packaging needs to be renewable.

Purpose: The standard developed would offer SanDisk’s packaging requirements will apply for all sale and shipping of microSD products. Packaging requirements are specified below (http://www.hp.com/packaging/Documentation/gse-2009.pdf   Pg 8).

Packaging requirements:

1. The material used in packaging is environmentally friendly. Focus is on reuse of shipping material, elimination of paper and packaging products, use of recycled material and/or recyclable materials.
2. Use reusable packaging for the shipments. The focus would be to be able to reduce packaging 25% and reuse 50% of the packaging. Provide guidelines for shippers and retailers. Guidelines to ensure:
   a) Pallets are reused
   b) Recyclable material are used for bulk packaging
   c) Reduction in individual Packaging materials for the SKU’s
   d) Promote recycling of individual packaging.
3. Material used for packaging is the general specification laid out in SanDisk environmental policy. All restricted material must be not be used in microSD packaging.
4. Ozone depleting substances like Hydrochlorofluorocarbons (HCFCs) and chlorofluorocarbons (CFCs) listed in SanDisk specifications for environment must not be used in plastic foam packaging.

5. Packaging material must not contain mercury, lead, chromium, cadmium or compound material of above substances more than 100 ppm.

6. Packaging material must not contain Polyvinyl Chloride (PVC). The tape covers material can be lineant if weight is less than 1.2 gm.

7. Only recyclable material needs to be used for packaging. Do not use materials such as foam cushions with adhesives or permanent glues.

8. Paper packaging material could be paper, paperboard, corrugated cardboard, corrugated fiberboard, etc.

9. Packaging materials be wrapped with thickness less than 22 microns (22um).

10. Packaging material can’t be from wild plant or wood material that originated illegally such as stolen from reserves, parks, harvested material without any permission. All packaging and pallets made of wood must be in accordance with the SanDisk’s environmental guidelines. Material will be marked with coding and must be visible and legible when packaging is open.

5.5 Package Weight and Contents:

The following table specifies the recommended package contents, weights and blister packaging for each microSD products:
<table>
<thead>
<tr>
<th>Description</th>
<th>Single Package Weight (grams)</th>
<th>Individual Weight</th>
<th>Contents (Apart from Unit)</th>
<th>Front Blister Weight</th>
<th>Back Blister Weight</th>
<th>Plastic Blister Weight</th>
<th>Master Carton Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>microSD™ 2GB</td>
<td>45</td>
<td>0.25</td>
<td>Plastic Jewel case</td>
<td>7.5</td>
<td>11.8</td>
<td>5.3</td>
<td>1.202 kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Warranty Information</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Security Sensor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>microSD™ 4GB</td>
<td>45</td>
<td>0.25</td>
<td>Plastic Jewel case</td>
<td>7.5</td>
<td>11.8</td>
<td>5.3</td>
<td>1.202 kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Warranty Information</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Warranty Information</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Security Sensor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>microSD™ 16GB</td>
<td>45</td>
<td>0.25</td>
<td>Plastic Jewel case</td>
<td>7.5</td>
<td>11.8</td>
<td>5.3</td>
<td>1.202 kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Warranty Information</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Security Sensor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>microSD 2GB</td>
<td>54</td>
<td>1.87</td>
<td>SD Adapter</td>
<td>7.5</td>
<td>11.8</td>
<td>5.3</td>
<td>1.202 kg</td>
</tr>
<tr>
<td>microSD 4GB</td>
<td>54</td>
<td>1.87</td>
<td>SD Adapter</td>
<td>7.5</td>
<td>11.8</td>
<td>5.3</td>
<td>1.202 kg</td>
</tr>
<tr>
<td>microSD 8GB</td>
<td>54</td>
<td>1.87</td>
<td>SD Adapter</td>
<td>7.5</td>
<td>11.8</td>
<td>5.3</td>
<td>1.202 kg</td>
</tr>
<tr>
<td>microSD 16GB</td>
<td>54</td>
<td>1.87</td>
<td>SD Adapter</td>
<td>7.5</td>
<td>11.8</td>
<td>5.3</td>
<td>1.202 kg</td>
</tr>
</tbody>
</table>

Table 4: Packaging weights, contents and blister description for each microSD

(Source: [http://sandisk.com/media/238849/sandisk%20mdds%20template%209-11-08.xls](http://sandisk.com/media/238849/sandisk%20mdds%20template%209-11-08.xls) Pg 2)
5.6 EMS Summary:

By taking steps to reduce waste from our design, operations and recycle, we can preserve the earth’s natural resources and enhance the quality of lives around the globe. It is everyone's responsibility to protect our environment.

This project provides an opportunity to fulfill our social responsibility. It’s small endeavor from our team to come up with eco-friendly methodology to put together the concepts of DFE and EMS into product design and development through EOL programs.

6.0 Economic Justification:

The economic justification of this project is aimed at shedding light on the potential financial benefits of this methodology. The methodology proposed here requires certain investments to be made by the company into areas such man power, infrastructure etc., which will all be handled by the company. Costs are calculated for the various solution options identified and the best fit is chosen. However the cost also varied depending on the size of the company and the size of the process in question. Our main areas of focus as mentioned in this method will be on Vendor Identification, Vender Selection, Vendor Classification, and Vendor Appraisal. The costs therefore involved would be those of manpower, administrative, legal, benefits and maintenance costs.

6.1 Executive Summary:

The Project “Eco Friendly Methodology Development for Sandisk” was undertaken by the team in September 2009 as a final year project. The project focuses on developing microSD compliant to environmental norms and Sandisk green policy. With the rapid growth of microSD and expected
market share in 2012 to be 55%, the product offers tremendous advantages to us (MAPA Consulting) to grow and to Sandisk to consolidate its position at the top manufacturer for microSD.

This project will be a launch pad for MAPA Consulting to be positioned as a high-end PLM service provider to the OEM and CM industry. The PLM market is expected to be approximately 20 Billion USD by 2012 and with more companies following the approach we see ourselves as one of the top service providers for OEM industry. Other than developing lifecycle approach for environmentally friendly products we would also provide consulting, Audit and Training services to the clients. We will extend the services to include vendor development, Vendor auditors and development of cost effective eco friendly packaging resource. We expect to grow from 1 client in 2010 to 15 clients by 2015.

Our financial projection for the project has an expected ROI of 15%. We seek $316,340 for the project. This is based on the manpower and overheads for a project life of for four Quarters. With a loss in first three quarters, we will breakeven in the last quarter. The net profit at the end of the project would be $47,451.

The Management Team members have strong backgrounds in project management and Environmental compliance. We have a total of over 20 years of experience. The team members work in OEM industry and know the basic needs of the industry. Puneet works for SanDisk and has been actively involved in Quality audits. Mahi has been in the semiconductor industry and has extensive knowledge of the product development. Atul has vast experience in OEM industry and his expertise includes in developing Product Lifecycle methodology. Akshay has great knowledge in computer applications and a great resource.

With most of companies investing in PLM, the PLM investments forecast continue to climb over the next five years. The compound annual growth rate of approximately 8.5% will have a market of approximately $30 billion by 2011. The potential market for our services is very promising.
6.2 Problem Statement:

In recent times the environmental impact of industrial activities has come heavily into public eye. This has resulted in many governments imposing various environmental compliance standards. Customers are now more aware of the harmful environmental impact of products and are more proactive towards being more environmental friendly. Technologies have been invented for recycling and re-use. However it is understood that implementing green principles at the very development of the product through all the life cycle phases can have the best impact in terms of recycling and re-usability.

The main problem identified in this scenario is the lack of proper procurement methodology’s which are green compliant. Most organizations have to constantly re-invent their procurement and End of life methods in accordance with the type of product and the environmental standards to be followed. In this light it is therefore important to have a proper green procurement strategy and product end of life (recycling and reusability) strategies since these are the two phases which determine most of the environmental impact caused. With new laws in enforcement companies which are not found in compliance with certain standards can face harsh penalties. Our project is aimed at developing methodology’s for OEM’s to facilitate green procurement and proper product end of life strategies.

6.3 Solution and Value proposition:

Our project aims to develop eco friendly procurement and end of life strategies. The clients are charged after considering factors such as size of the organization, the product line and process in question, the amount of resources that we will have to pull together externally and various other overheads such as transport costs, man power, and maintenance.

The following services will be offered:

- Developing a lifecycle for the product in sync with PLM, Green Principles and Environmental standards.
- Map the process flow of the product and define key deliverables at each phase
• Identify and select vendors
• Act as third party auditors to audit and approve vendors
• Develop procedures for product reuse and recycling
• Implement the PLM structure and procedures for product reuse and recycling
• Act as third party auditors to validate the recycling and reusability
• Continual evaluation for consistency

6.4 Market Size:

The market size for PLM solutions has increased over the past decade. With heavy industrial growth and new emerging markets across various geographic locations industries are paying more attention to getting more customized PLM solutions for their product lines. As forecasted by ARM the PLM solutions application revenue is bound to hit close to $20 Billion by 2012.

![Predicted PLM solutions revenue estimate](image)

Figure 12: Predicted PLM solutions revenue estimate
The demand for green electronic products has also increased over the years. Customers are now more aware of environmental impact and are therefore shifting towards products that are more environmentally compliant. According to a survey conducted by the Opera Project in Europe, consumers are moving more towards organic and green print electronics worldwide. In the following figure we can see the market size of green electronic products in comparison with semiconductor and flat panel display markets.

![Figure 13: Projected Market Size of Green Electronic Products in Comparison with Semiconductor and Flat Panel Displays](image)
As per the graph shown above the market size for green electronic products is projected to be close to $60 Billion by 2020. This shows that the market for green electronic products is rapidly growing.

Our service is a combination of these two concepts. Our service provides a solution to our clients which helps identify their areas of improvement in terms of environmental compatibility. This in turn results in financial gain for the company since the solutions proposed help them eliminate problems from a very early stage. The solutions are proposed with respect to Design for Manufacturability, Modularity, Reducing the Time to Market, Quality, Cost and Repeatability. Our services provide a modular solution which is repeatable and can gradually be applied to other product families as well.

Companies whose product lines are not compliant with standards such as ISO 14001, RoHS, EU RoHS etc., are being forced to recall their products and sometimes even cancel whole product lines which results in significant financial losses for the company. The cost spent for our consulting service is a small amount for long term gain which companies are willing to pay. There are currently a large number of OEM (Original Equipment Manufacturers) who are struggling to align their processes and product lines with Green and Environmental standards. Hiring third party consultancies to help them with this process gives them a clear solution and is more time and cost effective.

In this project we have chosen the microSD product line from SanDisk as our first customer.
6.4.1 Expected Growth of Micro SD:

Figure 14: Growth Trends of microSD (Source: www.sandisk.com)

<table>
<thead>
<tr>
<th>Revenue Mix (In %age)</th>
<th>2005</th>
<th>2007</th>
<th>2009</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile</td>
<td>13</td>
<td>35</td>
<td>45</td>
<td>55</td>
</tr>
<tr>
<td>Imaging</td>
<td>52</td>
<td>26</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>USB</td>
<td>12</td>
<td>14</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Audio and Video</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Gaming</td>
<td>3</td>
<td>3</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Other Products</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>License and Royalty</td>
<td>10</td>
<td>12</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>TOTAL REVENUE</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
The growth of MicroSD card has been phenomenal. 2007 saw a growth of 56%, 2008 had a growth of 66.6% and this is projected to go beyond 85% in year 2011. The largest use of micro SD is in Mobile phones industry which is projected to grow. Below gives an indication of the growth of Mobile phones. As mobile phones grow, the role of Micro SD will get bigger with smart phones replacing the regular phones.

With the mobile phone market expanding, the mobile phones have no longer remained as phones. They are smart phones with multiple uses. Apart from Smart phones, the microSD have found extensive use in cameras, Personal Computers, Navigation Systems, Printers to name a few.

With ever increasing demand for microSD in a spectrum of product range, we see this product as one of the front runners in SanDisk’s product range.
6.5 Competitors:

Currently there are very few companies that offer such a service of this kind. Most of the companies offer very specific services such as only auditing, validation and process improvement. Some of our key competitors are

- Siemens
- AMR Research
- Strategic Procurement Solutions
- A.T.Kearney Procurement and Analytical Solutions
- Procurement Solutions Inc.

However no one offers a complete solution such as ours which takes into consideration the PLM stages, Modularity, Product Quality etc., and more importantly continually evaluates the system for consistency. Our revenue forecast has been made based on this factor.

6.6 Customers:

Customers for our kind of service are in a large part OEM’s. Our solutions will be marketed directly to VP’s and Directors of the company. Since we will be dealing with high-level projects it is important for us to meet directly with people with authority in companies. We will explain to them the advantages of our services and propose solutions to them based on criteria such as

- The product life cycle: Additional Phases can be added to differentiate the EOL and EOM
- The deliverables at each phase can be redefined
- The vendor development process can be modified based on the environmental needs and the policies of the company
- Key factors to customize will be the target market, compliance criteria, IP and business needs

In this case we have chosen the SanDisk microSD line as our first client for the following reasons.
6.6.1 The need for new approach:

The manufacturing sector has realized the fact that traditional manufacturing processes are not enough for the growth they need. The traditional approach without innovation can prove costly and utilize a lot of time. As competition grows, every company needs to innovate for rapid emergence, to bring a revolutionary change. With ever increasing customer demand and awareness, the change is inevitable.

Even though SanDisk compound annual growth rate has increases by almost 45% in the last five years, the product gross margin have come down from 34% to almost 20%.

The products because of customer awareness or because of government regulations have to be green. The components need to comply with certain standards and the implications for going green have been 5-10% of the cost, approx 3-8cents per unit of microSD at SanDisk. This cost is an add-on to the existing cost. To absorb this cost into the existing cost new approach in processes is needed.

By introducing concept of green engineering in the microSD manufacturing, we plan to improve SanDisk’s sustainable, quantifiable lean and green design. We plan to introduce green manufacturing activities and develop a green engineering a product.

With government regulations, aware customers, green engineering is the requirement of the day. Green products are meant to increase quality of life. And while introducing green product we plan to reduce cost, and the environmental footprint of the microSD design, manufacturing and related activities. This includes raw material, logistics, recycling, and reuse.

Green engineering is getting thumbs up from the Government. A recent survey points to over 92% of young graduates want to work for a 'green' enterprise and in California, 9 out of 10 new venture capital applications relate to green.

Working on green product right in the beginning of the product lifecycle helps cutting costs and faster time to market. As shown below, any changes to an existing design costs the company fortunes. So in order to avoid the cost of changes, we plan to incorporate green at the very beginning of the project.
Eco-Friendly Methodology Development for SanDisk microSD line

San Jose State University, CA, U.S.A

With developing this project, we plan to increase the ROI and also create new markets which are critical of green products.

Figure 16: Effects of design changes due to adherence to compliance policies.

(Source: Professor Paul G. Ranky's Sustainable Green Design & Manufacturing Engineering Presentations

http://www.cimwareukandusa.com/All-Green/Ranky-GreenEngineering.html)
Implementing green in microSD product lifecycle would enable SanDisk to have the best fit systems. The company can then work on asset reduction by clubbing manufacturing processes of similar product line. By saving on design changes by implementing green right at the beginning of the product lifecycle, substantial cost of changes and cost of recall can be saved.

We would like to collaborate with internal and external resources like the supply chain, design group, materials department in a green focused environment.

Due to green product life cycle, we plan to reduce risk of costly recalls and/or legal issues

6.7 Costs:

Implementing our solutions will involve certain fixed and variable costs which are determined by factors such as size of the organization, the product line and process in question, the amount of resources that we will have to pull together externally and various other overheads such as transport costs, man power, and maintenance. We charge per project. For the SanDisk Corporation the cost break up for the entire year is given below:

<table>
<thead>
<tr>
<th>Expense</th>
<th>Q4 FY09</th>
<th>Q1 FY10</th>
<th>Q2 FY10</th>
<th>Q3 FY10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man Power required</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Total Man Hours Per Week</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Total Labor Cost per week @ $45 per hour</td>
<td>$2880</td>
<td>$4320</td>
<td>$4320</td>
<td>$7200</td>
</tr>
<tr>
<td>Total labor cost per Quarter (13 Weeks)</td>
<td>$37440</td>
<td>$56150</td>
<td>$56150</td>
<td>$93600</td>
</tr>
</tbody>
</table>

Table 5: Labor costs: (Based on current SanDisk project)

The labor costs shown above are charged according to the type of manpower being used. If external manpower is hired the labor costs will increase.
Assumed Overheads:

<table>
<thead>
<tr>
<th>Overhead</th>
<th>Q4 FY09</th>
<th>Q1 FY10</th>
<th>Q2 FY10</th>
<th>Q3 FY10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>$5,000</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Legal</td>
<td>$3,500</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>IP</td>
<td>$5,000</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>License and Government Permits</td>
<td>$6,000</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Administrative</td>
<td>$4,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
</tr>
<tr>
<td>Benefits @15% of labor</td>
<td>$5,616</td>
<td>$8,422</td>
<td>$8,422</td>
<td>$14,040</td>
</tr>
<tr>
<td>Utilities</td>
<td>$1,000</td>
<td>$1,000</td>
<td>$1,000</td>
<td>$1,000</td>
</tr>
<tr>
<td>Total</td>
<td>$30,116</td>
<td>$12,422</td>
<td>$12,422</td>
<td>$18,040</td>
</tr>
</tbody>
</table>

Table 6: Overhead (Based on current SanDisk project)

<table>
<thead>
<tr>
<th>Total Cost</th>
<th>Q4 FY09</th>
<th>Q1 FY10</th>
<th>Q2 FY10</th>
<th>Q3 FY10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Labor Cost</td>
<td>$37,440</td>
<td>$56,150</td>
<td>$56,150</td>
<td>$93,600</td>
</tr>
<tr>
<td>Total Overhead</td>
<td>$30,116</td>
<td>$12,422</td>
<td>$12,422</td>
<td>$18,040</td>
</tr>
<tr>
<td>Total Cost per Quarter</td>
<td>$67,556</td>
<td>$68,572</td>
<td>$68,572</td>
<td>$111,640</td>
</tr>
</tbody>
</table>

Table 7: Total Cost (Based on current SanDisk project)

Total cost for the project is: $316,340

6.8 ROI and P&L statement:

SanDisk Agrees to pay quarterly once the product is in production after 6 months of development as per details below:

- 20% in Q1 FY10
- 30% in Q2 FY10
30% in Q3 FY10

20% of total cost incurred and ROI after the completion of project

Desired ROI is 15%.

Total Revenue of the Project: Total Costs incurred + 15% ROI of the costs incurred = $363791

The P & L statement below shows our expenses, income and profit/loss for the quarters mentioned. At the end of the project the company will be paid its due and also reimbursed all the cost expenses incurred by us in the undertaking of the project.

```
<table>
<thead>
<tr>
<th>Quarter</th>
<th>Income</th>
<th>Expense</th>
<th>Profit/Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q4 FY09</td>
<td>$70,000</td>
<td>$80,000</td>
<td>($30,000)</td>
</tr>
<tr>
<td>Q1 FY10</td>
<td>$20,000</td>
<td>$30,000</td>
<td>($10,000)</td>
</tr>
<tr>
<td>Q2 FY10</td>
<td>$120,000</td>
<td>$100,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>Q3 FY10</td>
<td>$120,000</td>
<td>$70,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>Q4 FY10</td>
<td>$120,000</td>
<td>$30,000</td>
<td>$90,000</td>
</tr>
</tbody>
</table>
```

Figure 17: P&L
6.9 Price point:

The price for our solution is determined based on the amount the customer is willing to invest and the number of services required fixing the problem. The total amount of services provided, time spent, and external resources gathered and other expenditures incurred by us during the process will then be included into the quote which will be given to the customer. Initially we examine the problem the client is facing. Depending on the magnitude of the problem, we will identify the areas of improvement and the services which will be required to fix those problems. The initial inspection of the problem will cost the client depending upon

- The number of labor hours spent by MAPA associates
- Test resources used while identifying the root causes and measurement of impact

After the initial inspection stage is complete, we will explain our findings to the client and also find out the amount of money they are willing to invest into the project. Based on the clients offer, we will develop a quote consisting of all the charges and the percentage charges for MAPA associates. Depending on the magnitude of the problem the project could last anywhere between one quarter to 4 quarters. MAPA will charge quarter wise for its services.

Currently we charge 20% of the project cost incurred initially and then 30% in the following quarters. At the completion of the project the costs are reimbursed along with the ROI which we expect from the project. The total cost is determined by factors such as size of the organization, the product line and process in question, the amount of resources that we will have to pull together externally and various other overheads such as transport costs, manpower, and maintenance.

The other services provided are also charged separately on a fixed costs + overhead cost basis.
6.10 Norden-Rayleigh Curves:

Total budget estimated budget (d) is $400,000. Cumulative assessment of cost drivers where a = 0 is no risk and a = 1 is highest risk. The project work started off with high risk (75%) and went into low risk mode (20%) eventually. The table below illustrates computation of probability density function V(t) for t = 1, 2, …, 15 months.

<table>
<thead>
<tr>
<th>t (months)</th>
<th>a</th>
<th>e(-at^2)</th>
<th>V = d(1-e(-at^2))</th>
<th>V = 2adte(-at^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.75</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0.75</td>
<td>0.4724</td>
<td>2.11E+05</td>
<td>283441.9721</td>
</tr>
<tr>
<td>2</td>
<td>0.5</td>
<td>0.13536</td>
<td>3.46E+05</td>
<td>108290.6803</td>
</tr>
<tr>
<td>3</td>
<td>0.5</td>
<td>0.011111</td>
<td>3.96E+05</td>
<td>13337.01717</td>
</tr>
<tr>
<td>4</td>
<td>0.3</td>
<td>0.00823</td>
<td>3.97E+05</td>
<td>7904.490131</td>
</tr>
<tr>
<td>5</td>
<td>0.3</td>
<td>0.00055</td>
<td>4.00E+05</td>
<td>664.2175603</td>
</tr>
<tr>
<td>6</td>
<td>0.3</td>
<td>2E-05</td>
<td>4.00E+05</td>
<td>29.40819749</td>
</tr>
<tr>
<td>7</td>
<td>0.3</td>
<td>4.1E-07</td>
<td>4.00E+05</td>
<td>0.694772038</td>
</tr>
<tr>
<td>8</td>
<td>0.3</td>
<td>4.6E-09</td>
<td>4.00E+05</td>
<td>0.00882494</td>
</tr>
<tr>
<td>9</td>
<td>0.3</td>
<td>2.8E-11</td>
<td>400000</td>
<td>6.05609E-05</td>
</tr>
<tr>
<td>10</td>
<td>0.3</td>
<td>9.4E-14</td>
<td>400000</td>
<td>2.25283E-07</td>
</tr>
<tr>
<td>11</td>
<td>0.3</td>
<td>1.7E-16</td>
<td>400000</td>
<td>4.55354E-10</td>
</tr>
<tr>
<td>12</td>
<td>0.3</td>
<td>1.7E-19</td>
<td>400000</td>
<td>5.00975E-13</td>
</tr>
<tr>
<td>13</td>
<td>0.2</td>
<td>2.1E-15</td>
<td>400000</td>
<td>4.3695E-09</td>
</tr>
<tr>
<td>14</td>
<td>0.2</td>
<td>9.5E-18</td>
<td>400000</td>
<td>2.12652E-11</td>
</tr>
<tr>
<td>15</td>
<td>0.2</td>
<td>2.9E-20</td>
<td>400000</td>
<td>6.90217E-14</td>
</tr>
</tbody>
</table>

Table 9: Norden-Rayleigh Curves
The computed probability density function and Cumulative distribution function are plotted on graph as shown in figures:

Figure 18: Norden-Rayleigh Curves
6.11 Business and revenue model:

Our company provides unique solutions for a very specific market. Hence it is essential that we directly meet prospective clients and improve our contact database by means of thorough networking. We will initially provide our services to companies which are OEM’s, JDM’s and CM’s. The kind of services we will be offering will be in the following categories:

- Consulting
- PLM solutions
- Research
- Education services

We intend to make our presence felt in the following methods:

- We plan to ask our clients who we have worked with to refer us and endorse our services and products to their clients and partners.
- We will have a dedicated sales force team which will identify potential clients and directly go to them and explain the service and product.
- We will set up stalls at events such as Expo’s and conventions
- Offer clients sample demos etc., which will give them a better understanding of the product / service.

Revenue will be generated by these methods. We intend to give customers specific solutions customized to their requirements which will ensure good results. As mentioned above we will charge based on the size of the organization, type of product line and also the magnitude of the problem at hand.
6.12 SWOT Analysis:

The following is a SWOT analysis of our company which will help us identify our main strengths and weaknesses and the opportunities and threats to them. Our SWOT analysis tells us that we have equal number of strengths, weaknesses, opportunities and threats. This means we will require meticulous planning and good management all through.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Strong cross functional skill set</td>
<td>● Limited resources</td>
</tr>
<tr>
<td>● Supply chain vendor relationships</td>
<td>● Limited PLM knowledge (for some team members)</td>
</tr>
<tr>
<td>● PLM structure, procurement processes and</td>
<td>● Target cost database</td>
</tr>
<tr>
<td>EMS in place</td>
<td>● Customer contracts</td>
</tr>
<tr>
<td>● Strategically focused team</td>
<td>● Approval of process budget</td>
</tr>
<tr>
<td>● Over 20 man years of cumulative work</td>
<td>● Manage change with rev control</td>
</tr>
<tr>
<td>experience</td>
<td>● Design cost targets alignment to quote</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Create procurement strategies for client</td>
<td>● Increased business liabilities with unique</td>
</tr>
<tr>
<td>● Develop scalable process to support growth</td>
<td>requirements</td>
</tr>
<tr>
<td>● Define roles and responsibilities</td>
<td>● Aggressive schedules to implement the unique</td>
</tr>
<tr>
<td>● Enhance business model performance</td>
<td>procurement process</td>
</tr>
<tr>
<td>● Support key supply chain processes</td>
<td>● Major time investments in time to define and</td>
</tr>
<tr>
<td>● Strategic relationships with vendors and</td>
<td>document the process</td>
</tr>
<tr>
<td>suppliers</td>
<td>● Cross functional available bandwidth</td>
</tr>
<tr>
<td>● Improve flow of information</td>
<td>● Internal alignment of priorities</td>
</tr>
<tr>
<td></td>
<td>● Strategy to support different customers</td>
</tr>
<tr>
<td></td>
<td>● Available capacity</td>
</tr>
</tbody>
</table>

Figure 19: SWOT Analysis
6.13 Personnel:

The number of personnel required might vary depending on the service we have to offer. This might sometimes mean hiring temporary contract engineers and specialists. However the core of the company will be the main founders Atul Handa, Mahi Arya, Akshay K Rao and Puneet Abbott who are also the main upper management. Their responsibilities will include Identifying potential clients, maintaining business relationships with our clients, financial management of the company and the strategic planning.

Specifically each member of the upper management will also have the following responsibilities based on their experience and education.

- **Atul Handa (CEO)**: Process design, Supply chain analysis, recruitment
- **Puneet Abbot (Director)**: Environmental management systems, Corporate quality and Project management
- **Akshay K Rao (Director)**: Product life cycle management, Operations and logistics, Process improvement, Sales
- **Mahi Arya (Director)**: Compliance, Procurement, Quality and Product design

Apart from the above responsibilities we will also be responsible for handling our team of Green Engineers, Supply Chain Analysts, Business Analysts, System Engineers and a dedicated sales force team. The fixed personnel strength of the company will be around 50 employees. Depending on the requirement temporary contractors might be hired.

6.14 Exit Strategy:

For any start-up company having an exit strategy is vital and important. There could be a lot of scenarios where we fail to achieve our planned ROI such as having less number of clients or a competitor who is offering a better product / service. If any of these events occur, MAPA associates plans to either
• Merge with a competitor: A merger with a rival competitor will result in MAPA Associates having more resources such as a better sales force, access to more professional talent, a larger clientele, better Research and Development, possible entry into different markets and more importantly large revenues. In the case of a merger there will be an equal share for both companies and revenues will be shared equally.

• Selling to a competitor: Since we provide unique customized solutions, we expect selling to a direct competitor to be relative easy. The competitor in turn will gain access to a large client database, the best professional labor in the market, a large variety of products and services to be offered and also the opportunity to generate more revenue.

There could also be the scenario when the company does not achieve desired targets with our clients. In these cases it is important to have a back up contingency strategy ready to be employed so that the income flow for our company does not get affected. In such cases some of our contingency plans are:

• Outsourcing the projects at hand to third party companies
• Reducing the scope of the project
• Hire external intelligence and predict the best course of action
• Work more closely with our clients and getting external help to meet their requirements
• Procure finances from banks and other sources
• Investigate into current causes of failure and redefine business model and protocols

In the event of such happenings our main priority will be to complete the given project or make sure the work is handed over to another reliable company so that our relationships with clients are not affected. Afterward the company might go into a small break where we will take no new clients and investigate and fix the causes for failure.
7.0 Conclusion:

The environmental friendly project for microSD line is well equipped with a great deal of product management optimization and environmental engineering solutions. The methodology offers a quick evaluation of microSD line to qualify that the product meets SanDisk’s green specifications, producibility and disposability standards. It provides emphasis on green technology standards and product management methods to offer consistency, repeatability, and substantially reduce redundancy. The flow ensures the product can be reused, recycled and waste is reduced upon end of Product life.
Appendix:

A) Gantt chart
### B) Environmental Management System Checklist for vendor rating:

<table>
<thead>
<tr>
<th>Question</th>
<th>1. Environmental Management Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Does the supplier have an environmental management system?</td>
</tr>
<tr>
<td>1.2</td>
<td>Does the supplier have a written environmental policy with objectives that identifies the environmental impacts of the business?</td>
</tr>
<tr>
<td>1.3</td>
<td>Has executive management identified a representative to execute the environmental policy and objectives throughout the organization?</td>
</tr>
<tr>
<td>1.4</td>
<td>Does the supplier have and use a documented procedure to meet targets for environmental objectives?</td>
</tr>
<tr>
<td>1.5</td>
<td>Is the environmental management system reviewed periodically by executive management to ensure its effectiveness?</td>
</tr>
<tr>
<td>1.6</td>
<td>Is there a training program for employees regarding environmental policy and objectives?</td>
</tr>
<tr>
<td>1.7</td>
<td>Is there a person in charge and a system in-place to track environmental laws and regulations that are relevant to the supplier?</td>
</tr>
<tr>
<td>1.8</td>
<td>Does the supplier environmental policy to ensure environment compliance to all local laws/regulations and regulate the release of harmful emissions to the environment [emission into the air, discharge into water supplies, soil pollution, noise and vibration, etc.]?</td>
</tr>
<tr>
<td>1.9</td>
<td>Does the supplier environmental policy required a program for energy conservation and recycling?</td>
</tr>
<tr>
<td>1.10</td>
<td>Does the supplier policy have a emergency preparedness and response program?</td>
</tr>
<tr>
<td>1.11</td>
<td>Does the supplier environmental policy require evaluation of environmental aspects and impacts?</td>
</tr>
<tr>
<td>1.12</td>
<td>Does the supplier environmental policy requires records maintenance and defines a required time period for records?</td>
</tr>
<tr>
<td>1.13</td>
<td>Does the company have records to demonstrate success with a working program for continual improvement of environmental issues?</td>
</tr>
<tr>
<td>1.14</td>
<td>Does the policy require that hazardous substances stored and disposed of in an environmentally friendly way?</td>
</tr>
<tr>
<td>1.15</td>
<td>Does the company policy require life-cycle assessments for processes and products?</td>
</tr>
</tbody>
</table>

### 2. Controlled and Reportable Substances Disclosure

<table>
<thead>
<tr>
<th>Question</th>
<th>2. Controlled and Reportable Substances Disclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Does the company use RoHS directives banned substances in processing of product?</td>
</tr>
<tr>
<td>2.2</td>
<td>Does the supplier environmental policy require controlled and reportable substances review for purchased parts and materials per industry standards and customer requirements</td>
</tr>
<tr>
<td>2.3</td>
<td>Does the supplier environmental policy require controlled and reportable substances review of packaging materials (shipping boxes, trays, etc.)?</td>
</tr>
<tr>
<td>2.4</td>
<td>Does the supplier have well defined Controlled and Reportable Substances requirements for 2nd tier suppliers per industry standards and customer requirements</td>
</tr>
<tr>
<td>2.5</td>
<td>Does the new supplier selection criteria require have well defined controlled and reportable substances requirements for 2nd tier suppliers.</td>
</tr>
<tr>
<td>2.6</td>
<td>Does the supplier have a copy of SanDisk Green policy document and has formal review of the list of controlled and reportable substances been done?</td>
</tr>
</tbody>
</table>

### 3. Reporting
### 3.1 Does the supplier require its 2nd tier suppliers to provide full chemical disclosure during the product/ material qualification phase?

### 3.2 Does the supplier maintain a adequate chemical disclosure database for product/ material supplied to SanDisk based on 2nd tier supplier’s chemical disclosure dataset?

### 3.3 Does the supplier have capability to provide a chemical disclosure report at homogenous level and in SanDisk format (including CAS #...etc)?

### 3.4 Does the supplier have a system in place to provide a detailed chemical disclosure report within 5 business days of request from SanDisk?

### 4. Audits

#### 4.1 Is procedures in-place for periodic audits of the environmental management system?

#### 4.2 Is procedures in-place to audit supplier for chemical disclosure compliance through periodical ICP/SGS testing?

#### 4.3 Is there a procedure in place that will monitor on a regular basis and ensure that outgoing materials meet SanDisk Green requirements, like periodical lab testing, etc.?

### 5. Product Legal Environmental Regulations

#### 5.1 Does the supplier have access to copies of the following environmental regulations and has a applicability analysis been conducted for all supplier parts?
- EU RoHS
- China RoHS
- EU Packaging Directive
- EU Battery Directive
- EU WEEE Directive
- EU REACH
- EU EuP
- Others: Please list

#### 5.2 Is there a procedure in place to ensure compliance with all applicable environmental regulations above?

### C) Acronyms Used:

- **PLM**: Product Lifecycle management
- **MRD**: Marketing Review Document
- **BOM**: Bill of Material
- **EOL**: End Of Life
- **EOM**: End Of Manufacturing
- **AVL**: Approved Vendor List
- **RoHS**: Restriction of Hazardous Substances Directive
- **Reach**: Registration, Evaluation, Authorization and restriction of Chemical substances EUREACH: European Union REACH
- **NDA**: Non Disclosure Agreement
- **GBA**: General Business Agreement
- **EDI**: Electronic Data Interchange
- **MDDS**: Material Declaration Data Sheet
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GEMS: Green Environment management System
MDSS: Material Decision Support System
SRS: Suppliers Rating System
EMS: Environmental Management System
WEEE: Waste Electrical and Electronic Equipment Directive
PVC: Poly Vinyl Chloride
OEM: Original Equipment Manufacturer
SKU: Stock Keeping Unit
EOL: End-of-Life
DFE: Design for Environment

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