



Product Lifecycle Management

An evening workshop

TIMETABLE

17.00 – 17.30 Registration and tea

17.30 – 18.15 Introduction and first session

– Understanding product lifecycle management (PLM)

18.15 – 18.45 Supper and break out session

18.45 – 19.15 Second session

– Waste regulations + Case study (BT)

19.15 – 19.30 Break out session

19.30 – 20.00 Third session

– Solution approaches for effective PLM



Have you ever wondered what happens to
your products?

PRODUCT LIFECYCLE MANAGEMENT



- Mass Production
 - Production Scheduling
 - Inventory Management
 - Resource Management

PRODUCT LIFECYCLE MANAGEMENT



- Supply Chain Management
 - Distribution Network Management
 - Warehouse Management
 - Collaborative Planning, Forecasting, and Replenishment (CPFR)

PRODUCT LIFECYCLE MANAGEMENT



- Customer Relationship Management
 - Mass customisation
 - “Products” to “Services”
 - Warranties etc.

PRODUCT LIFECYCLE MANAGEMENT



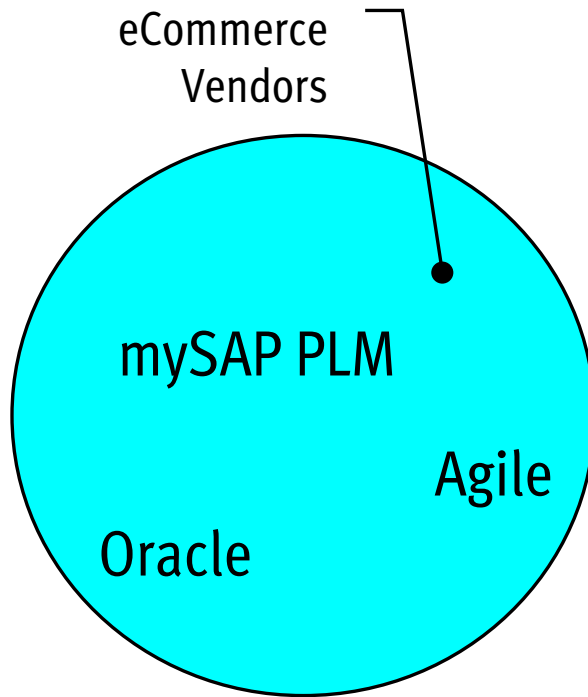
- Product Lifecycle Management
 - Take back programs
 - “Like for like” exchanges
 - End-of-Life (EOL) Management



COMMERCIAL PLM SOLUTIONS

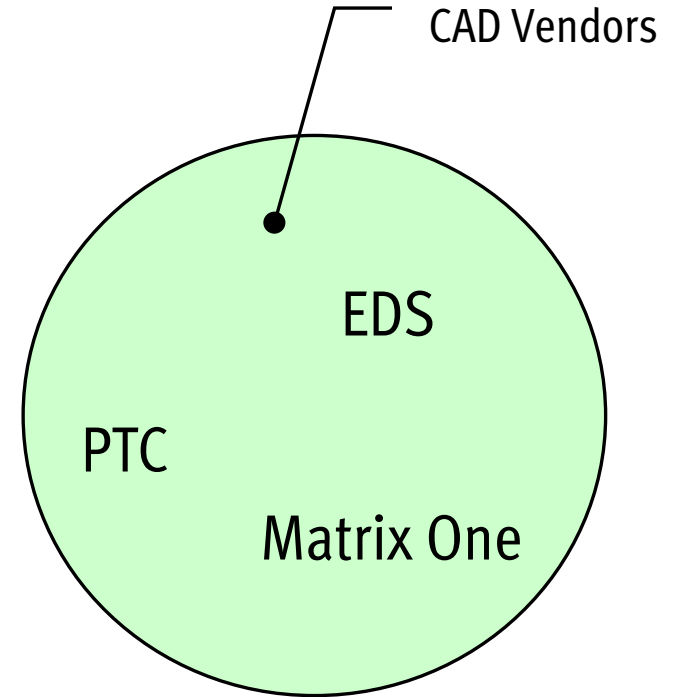
- Latest among the series of e-commerce solutions
 - Estimated industry spending on PLM to reach \$5.25 billion by 2005
- Main focus on “Collaborative Design”
 - cPDM (Collaborative Product Data Management)
 - Sharing CAD/CAM data
 - Product definition languages (STEP, EXPRESS, etc.)
- Manages product data from design through to usage/maintenance

COMMERCIAL PLM SOLUTIONS



Enterprise view

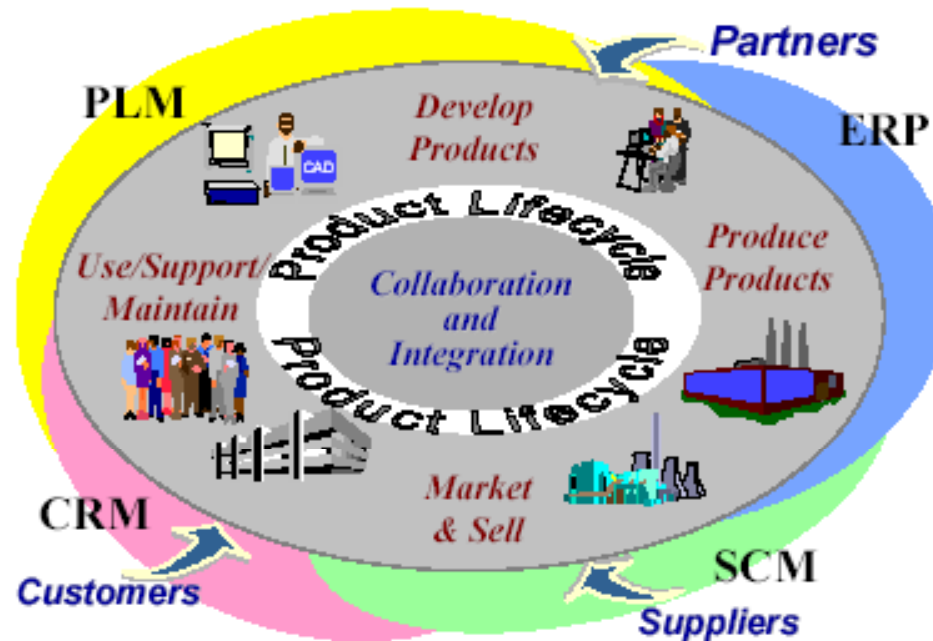
Consumer electronics, CPG, Pharma, etc.



Design view

Automotive, Heavy equip., A&D, etc.

COMMERCIAL PLM SOLUTIONS



Relationships Among Enterprise Solutions

“End-of-Life” component is missing

PRODUCT LIFECYCLE MANAGEMENT



- Consider complete supply chain

EOL MANAGEMENT



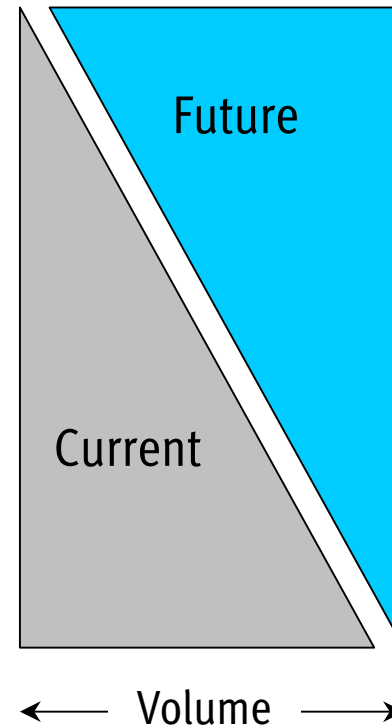
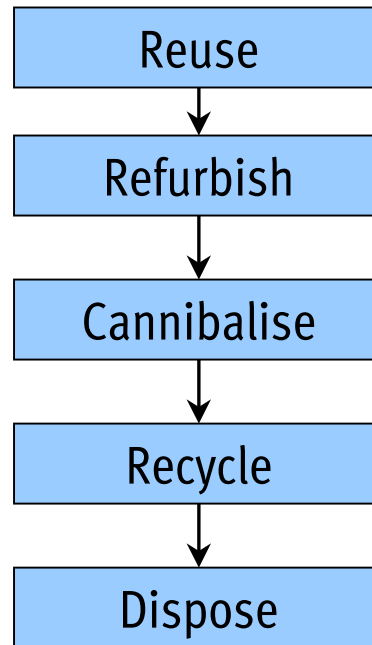
- Consider complete supply chain
- EOL management
 - “Those activities required to retire a product after the user discards it after its useful life.”

WHY EOL MANAGEMENT?

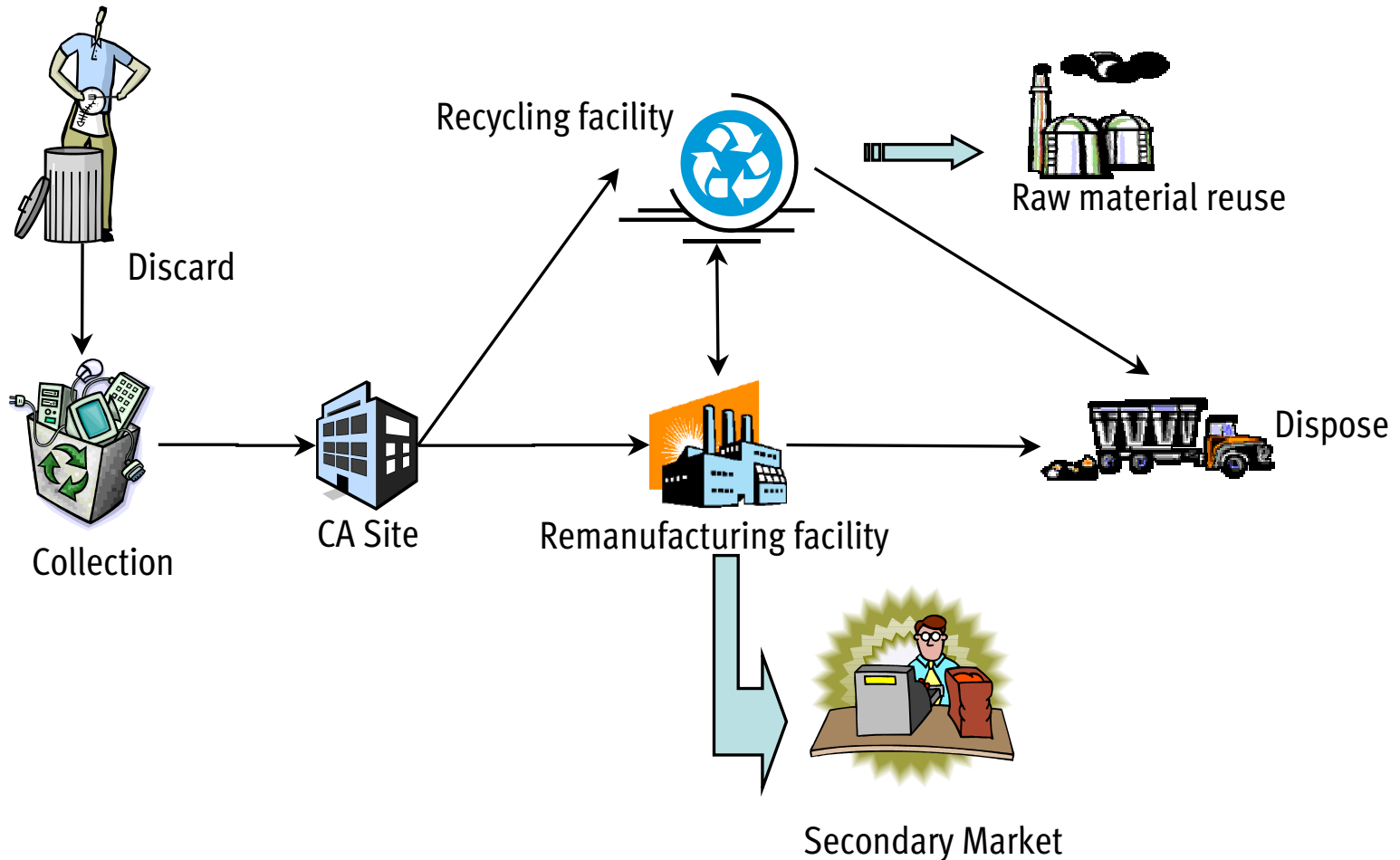
- Legislative drivers
 - Waste of Electrical and Electronic Equipment (WEEE) Directive
 - Reduction of Hazardous Substances (RoHS) Directive
 - EU Packaging Directive
 - End-of-Life Vehicles (ELV) Directive
- Financial motives
 - There is money to be made in efficient EOL management
 - Multiple revenue streams from a single product
- New marketing opportunities
 - cf automobile dealer trade-ins
 - “green” image

WHAT HAPPENS TO “SCRAP”?

Objective: Maximise product recovery

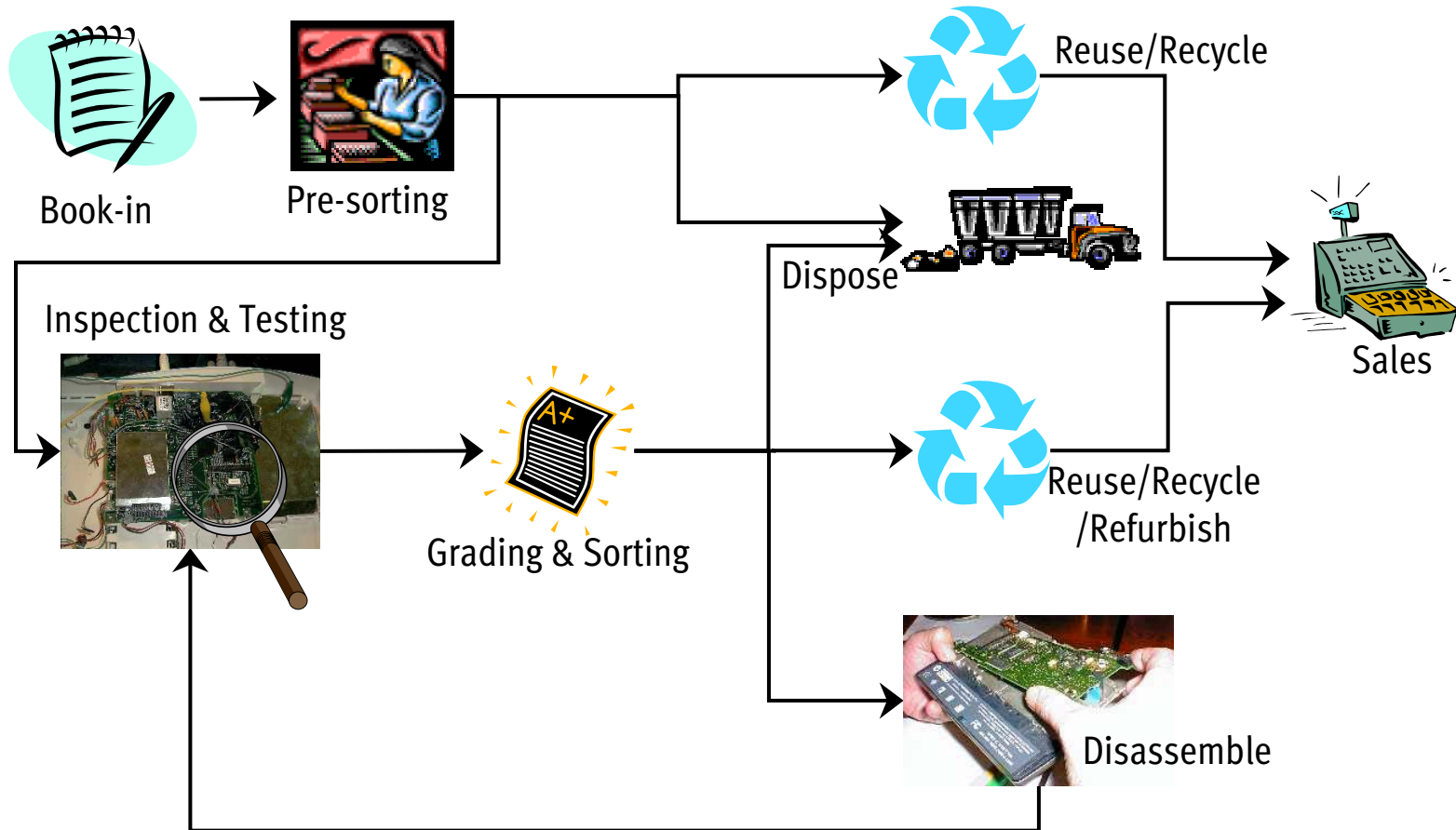


WHAT HAPPENS TO “SCRAP”?

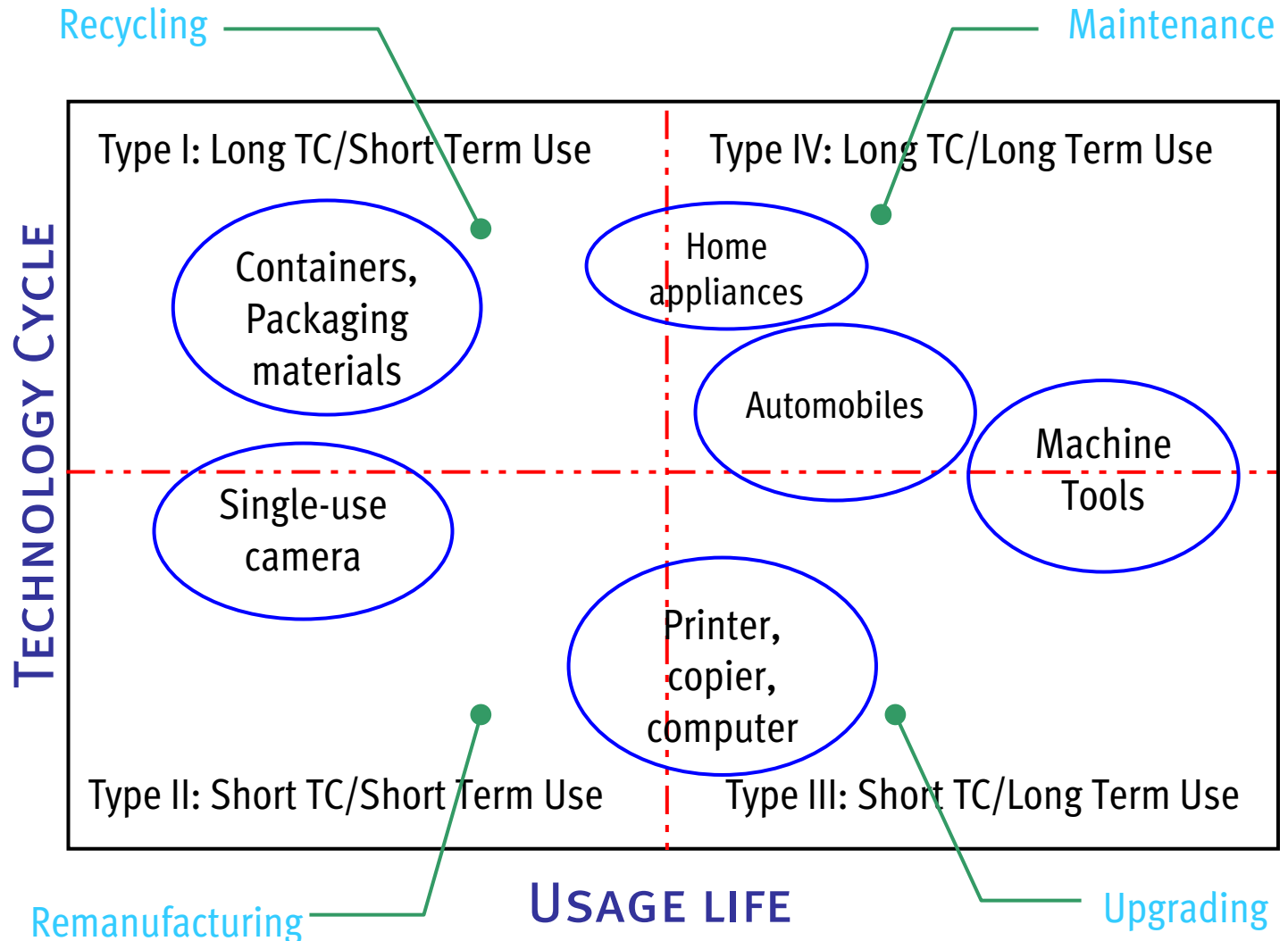


WHAT HAPPENS TO “SCRAP”?

Remanufacturing/Refurbishing



PRODUCT CHARACTERISTICS AND EOL STRATEGIES





A look at the UK product recovery industry

PROFILE

- 10 companies
 - 3 computer remanufacturers
 - 1 photocopier remanufacturer
 - 1 phone remanufacturer
 - 3 computer dismantlers
 - 2 fridge recyclers

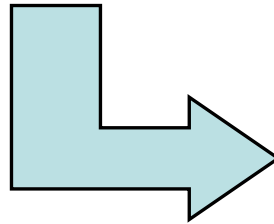


KEY FEATURES

- Largely unorganised
- Labour intensive
- Low margins
- Information shortage a major issue






TYPE OF COMPANIES

- Who
 - Manufacturers
 - Third party
 - Independent



- Information availability
- Risk management

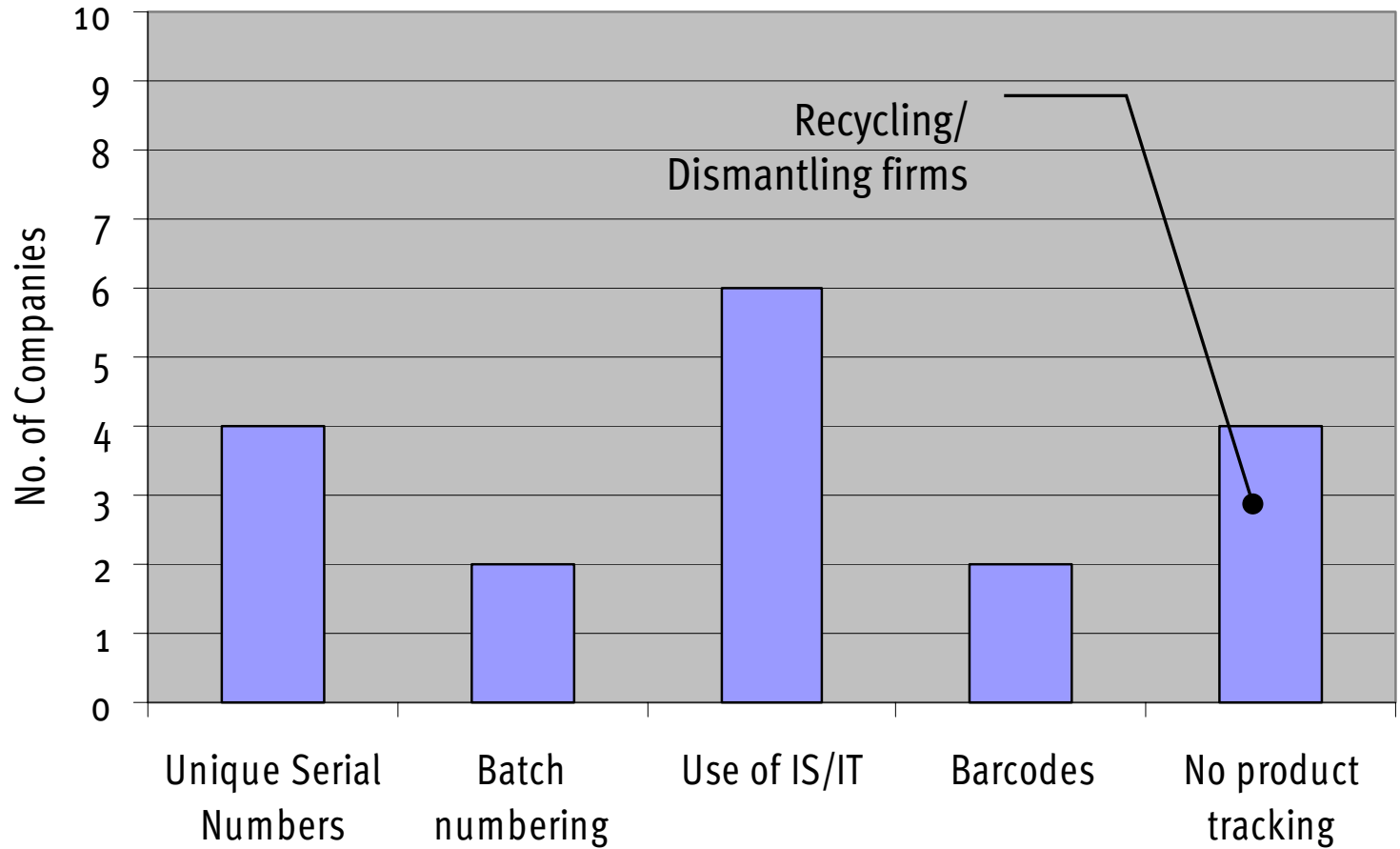
WHERE DOES IT COME FROM?

- Warranty returns 
- Leasing companies 
- Consumer/business disposals  – Quality of products
- Retailer/Manufacturer take back  – Uncertainty
- Municipal council collection facilities  – Information availability



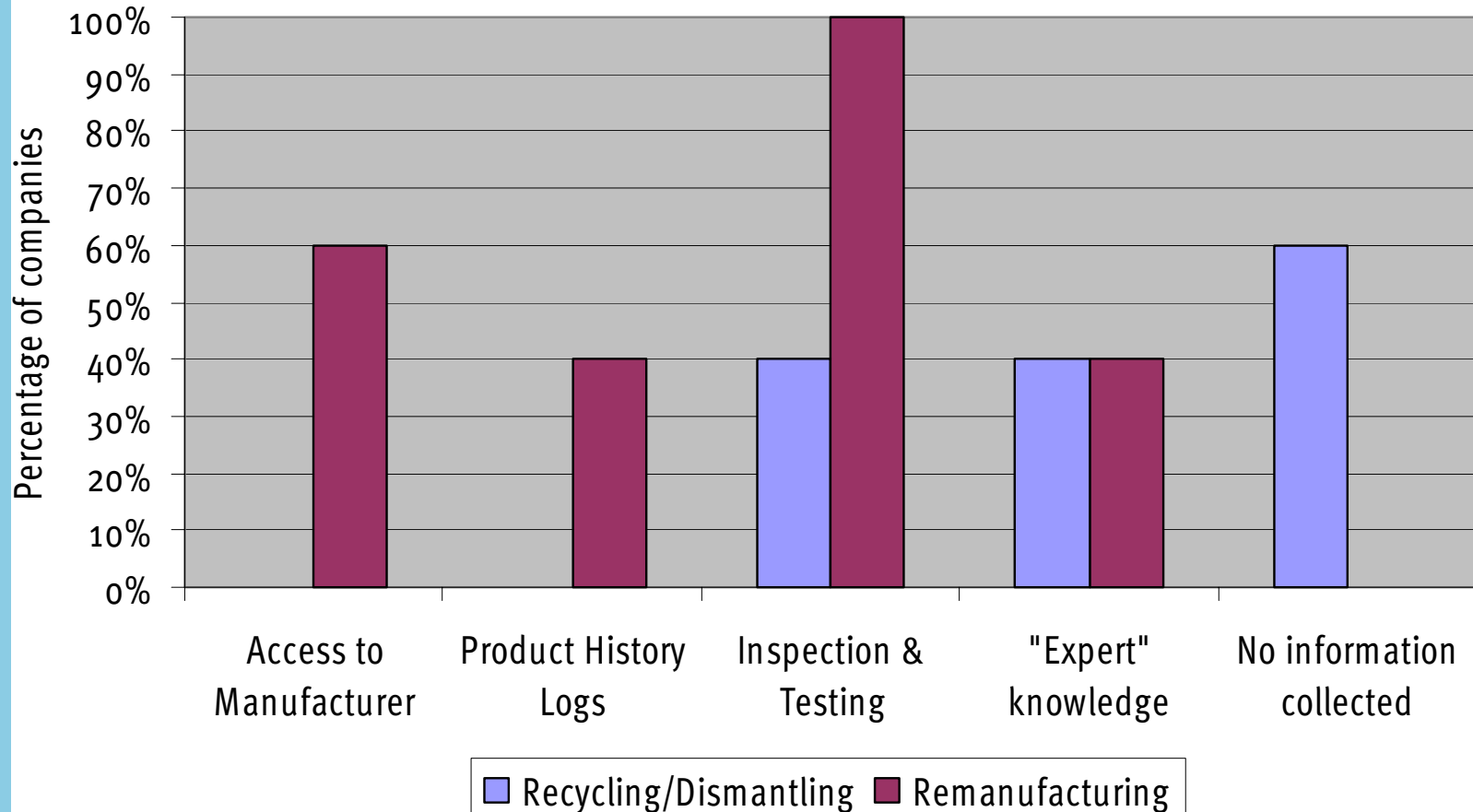
Choice of Recovery Option

PRODUCT TRACKING

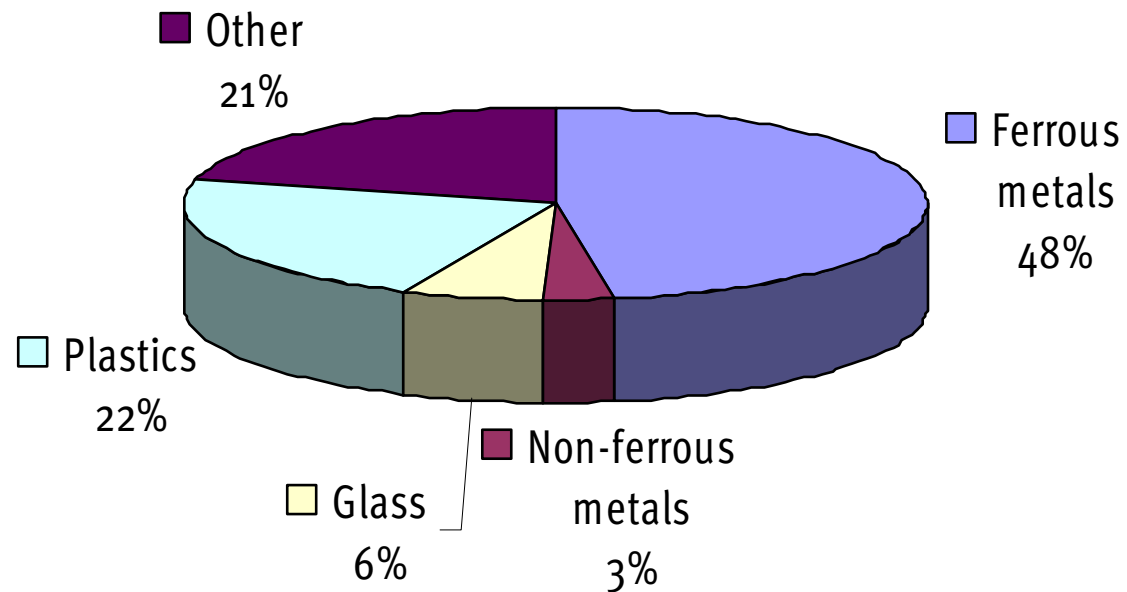


INFORMATION AVAILABILITY

Q: Will increased information availability result in increased rates of reuse?

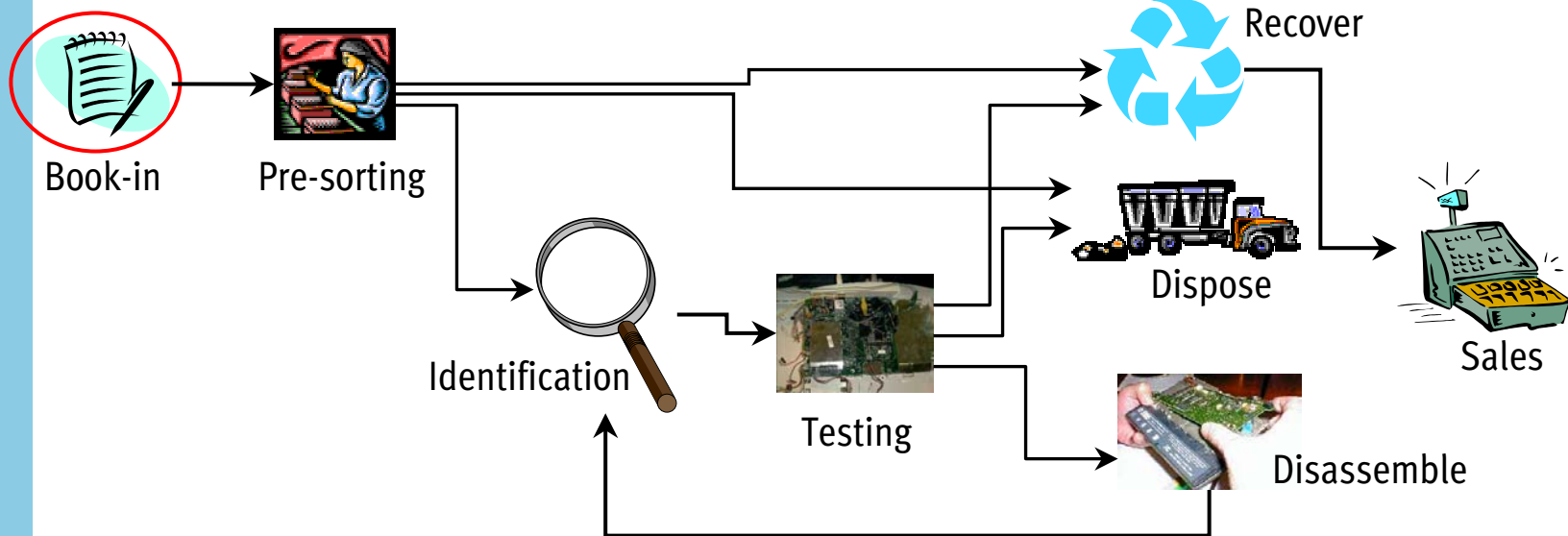


WHAT IS ELECTR(ON)IC WASTE MADE OF?



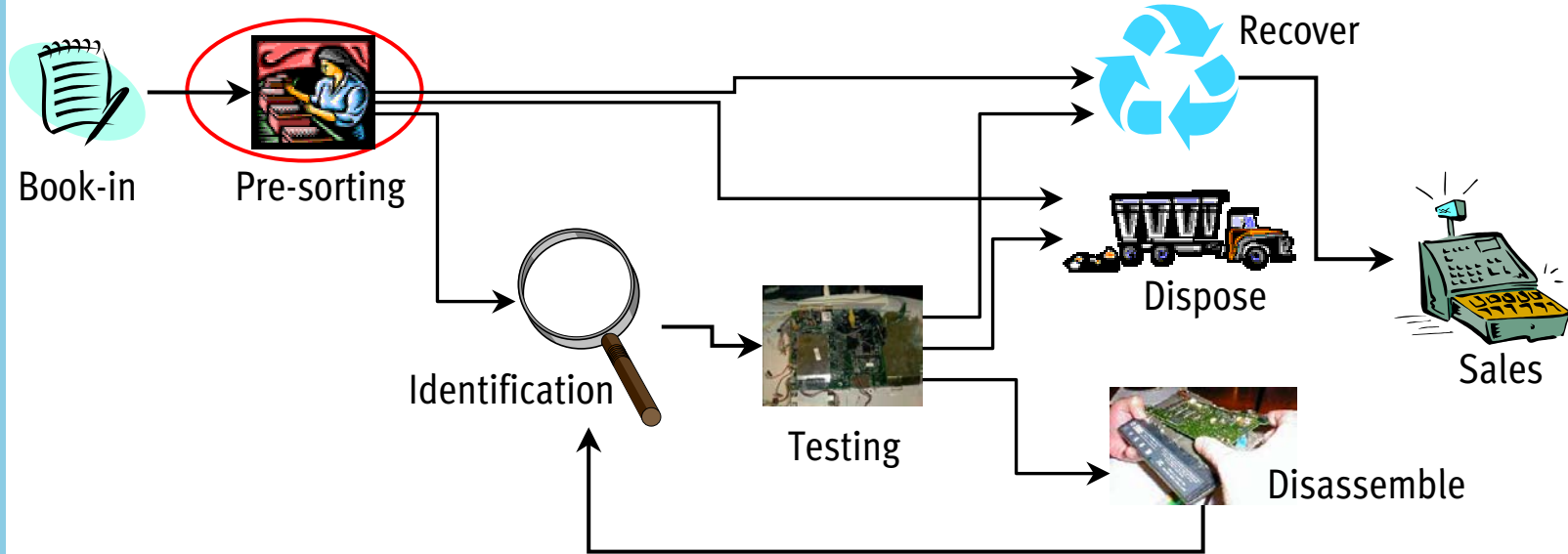
INFORMATION COLLECTION

Laptop
 Brand: {Dell, IBM, Compaq,...}
 Model: i386 ~ P4
 Speed: 133Mhz ~ 4.2 GHz
 HDD: 60MB ~ 200GB
 Condition: {Good, Bad}



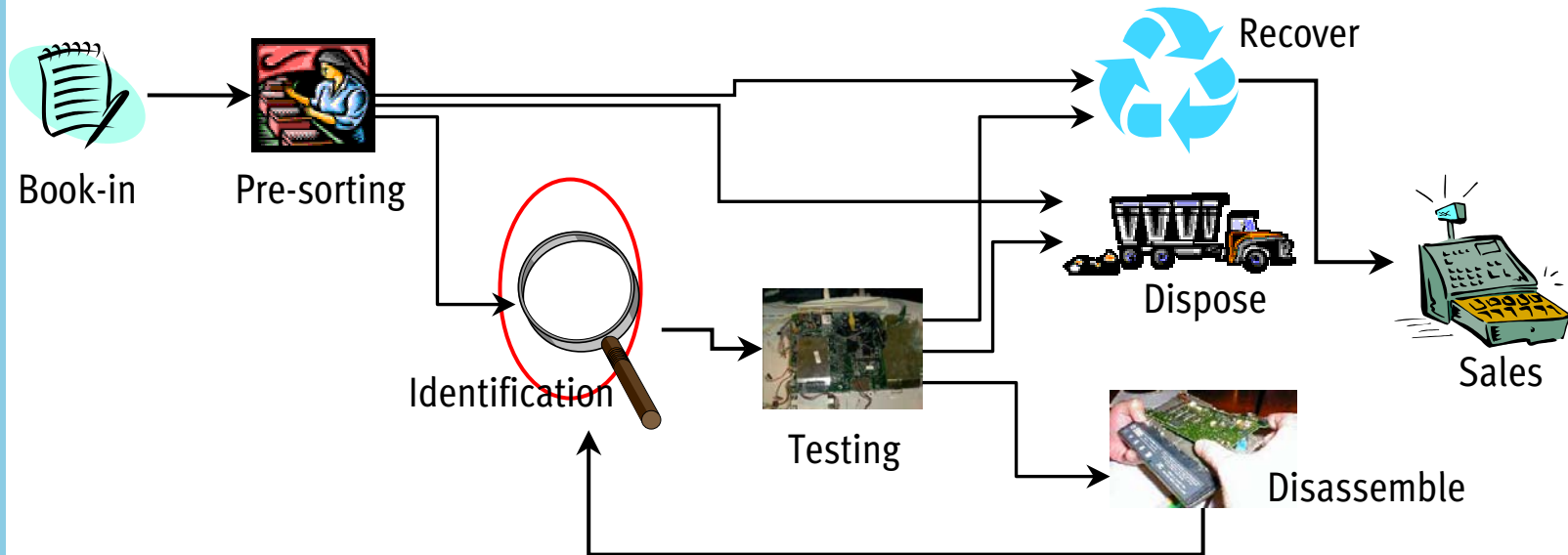
INFORMATION COLLECTION

Laptop
 Brand: Dell
 Model: P2
 Speed: 200Mhz ~ 500 MHz
 HDD: 1GB ~ 20GB
 Condition: {Good, Bad}



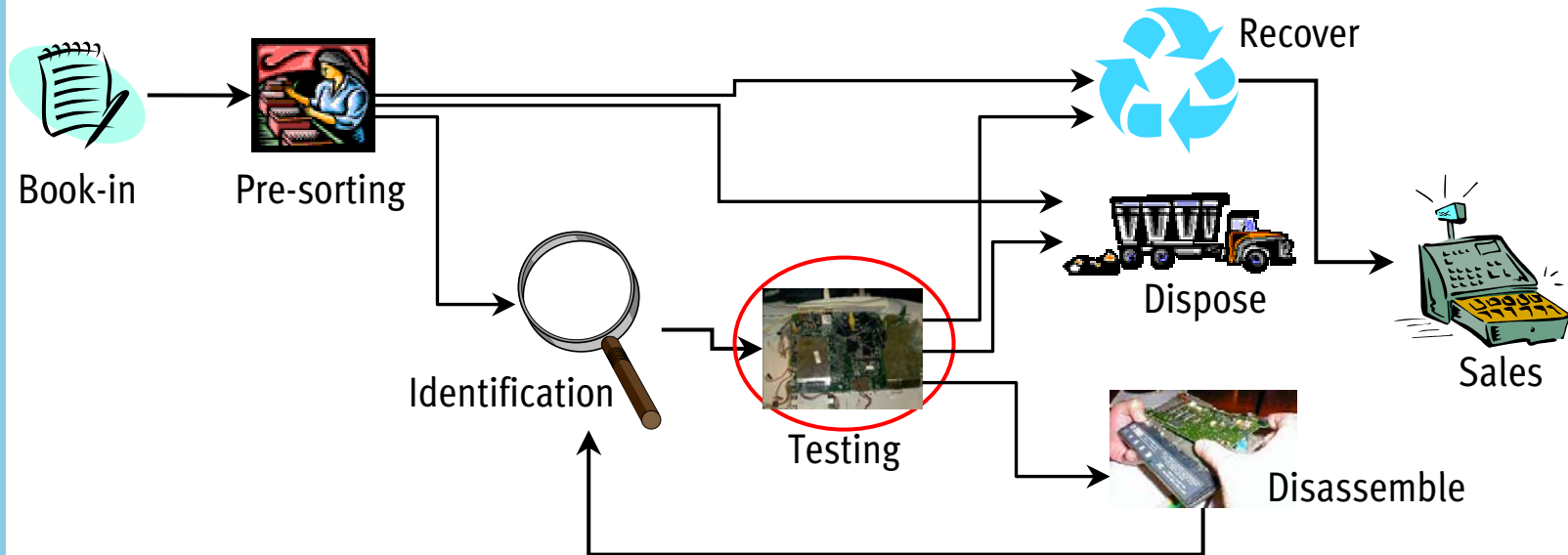
INFORMATION COLLECTION

Laptop
 Brand: Dell
 Model: P2
 Speed: 500MHz
 HDD: 100GB (!!)
 Condition: {Good, Bad}



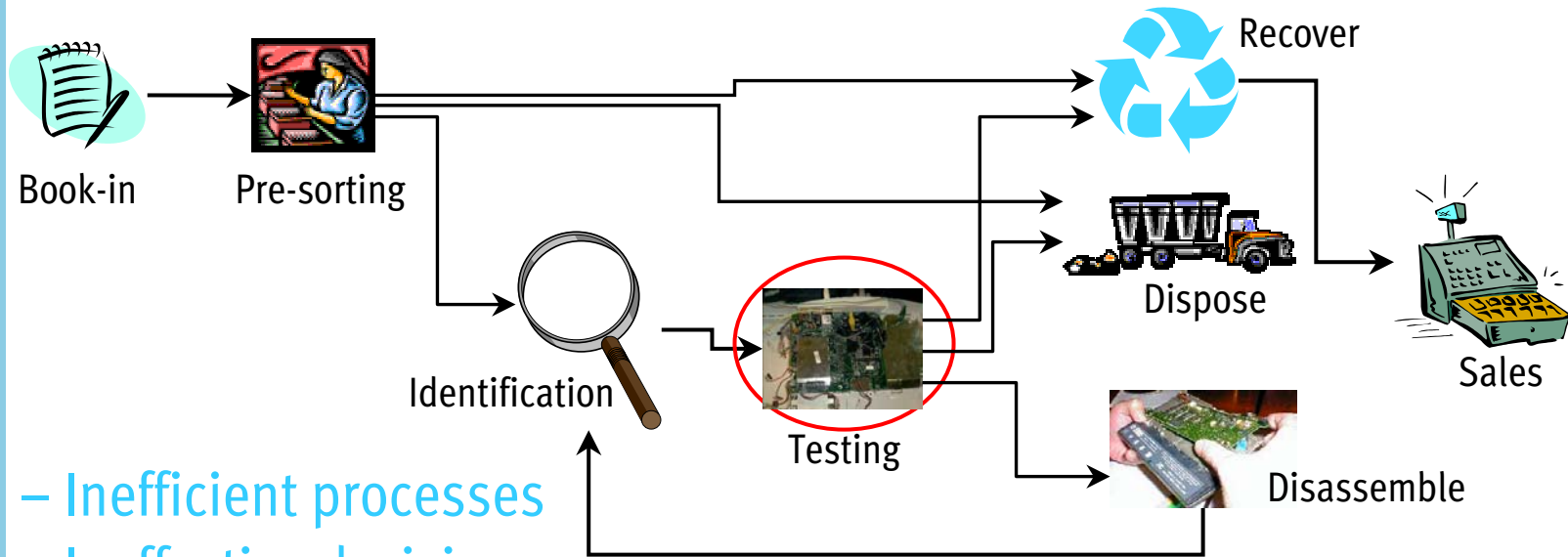
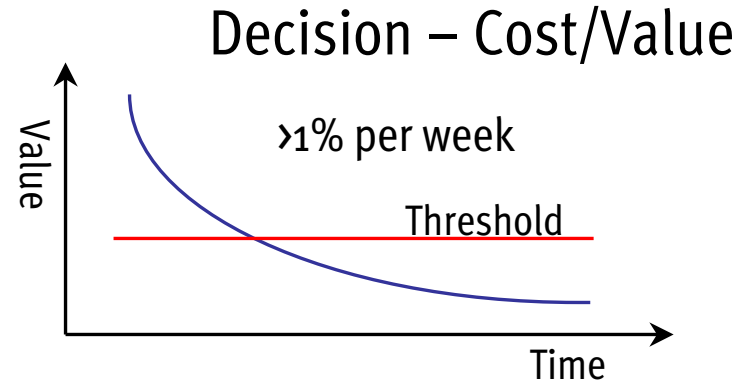
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INFORMATION COLLECTION

Laptop
 Brand: Dell
 Model: P2
 Speed: 500MHz
 HDD: 100GB (!!)
 Condition: Good



- Inefficient processes
- Ineffective decisions

DECISIONS & INFORMATION REQUIREMENT

Decisions made

- Pre-sorting
 - What is it?
 - Inspect?
- Recovery
 - Which recovery option?
- Disassembly
 - Optimum disassembly level?
 - Best disassemble sequence?
- Sales
 - Which channel to sell to?
 - How much is it worth?

Information Required

Brand, model, quality, age, etc
Expected value, Insp. cost

Product structure, Material content, Market information, Regulations

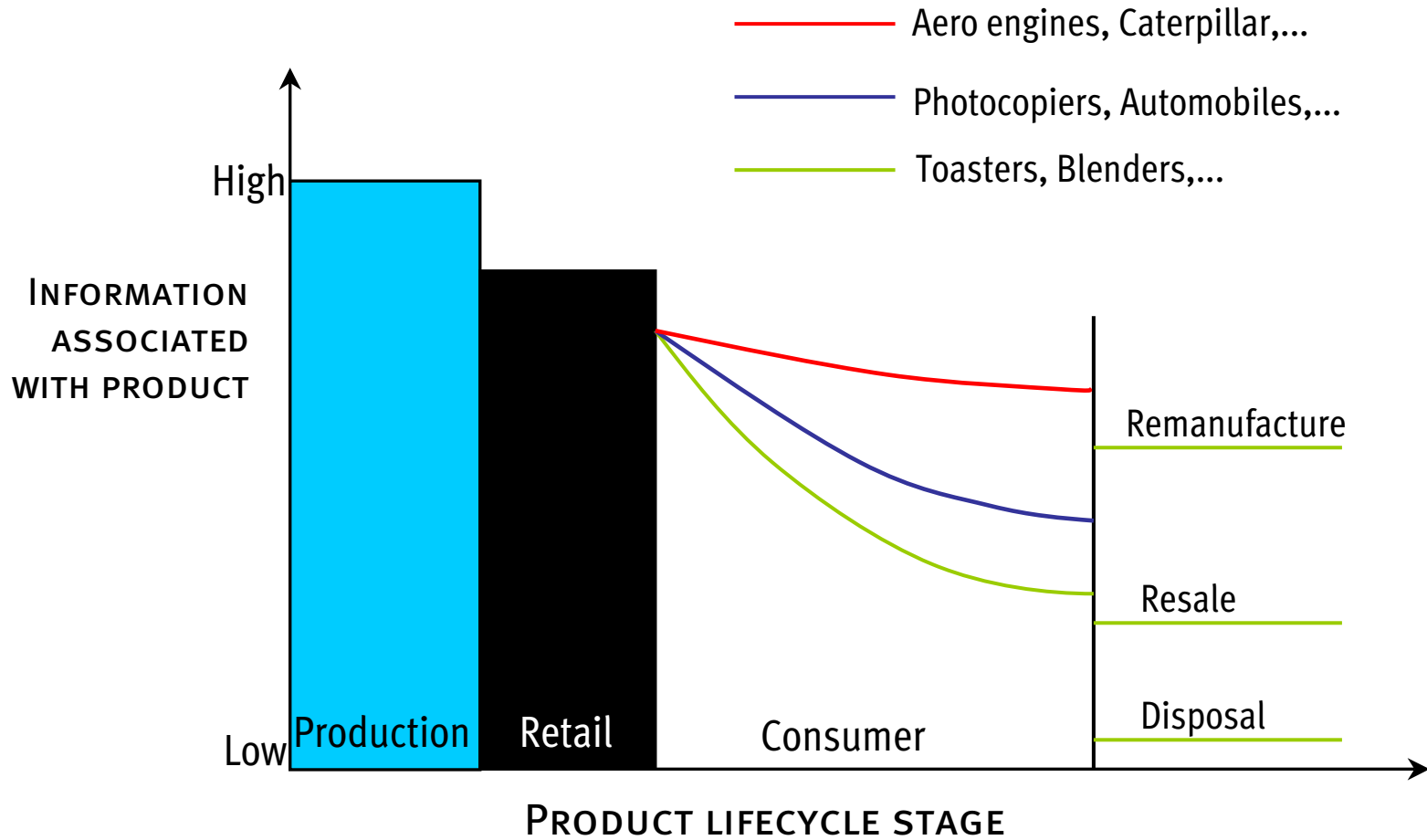
Expected residual value, Disassembly cost

Disassembly instructions

Product info, Market info

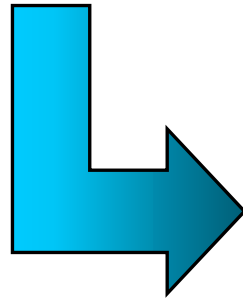
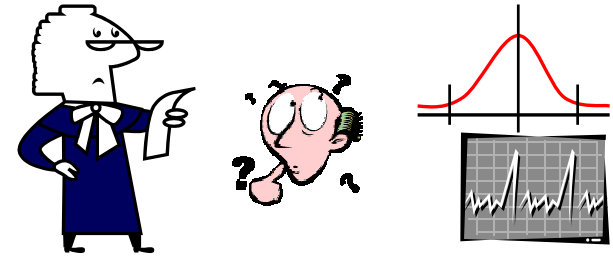
Brand, model, quality, age, last user, etc

INFORMATION “LOSS”



ISSUES

- Supply oriented – enforced push system
- Uncertainties in quantity, quality, and timing
- Lack of information
- Immature secondary market
- Legislative pressures



- no control
- uninformed decisions
- not optimised

Revenue -> Cost



BREAK OUT SESSION 1

- In this session you will
 - Classify your products according to the length of technology cycle and usage life
 - Identify the ideal EOL strategy for your products
 - Come up with other possible product characteristics that could influence EOL strategies
- You will also
 - Ask yourself what happens to your products at EOL today, and
 - What should ideally happen to them in future

PRODUCT CHARACTERISTICS

- Design cycle
- Functional complexity
- Number of parts/materials
- Reason for obsolescence
- Second-hand market value
- Recycling value of materials
- Disassembly costs
- Availability of recycling technologies
- Supply chain factors
- ...



Waste Regulations

WASTE REGULATIONS

- Waste from Electric and Electronic Equipment (WEEE) Directive
- Restriction of Hazardous Substances (RoHS) Directive
- Packaging Directive
- 44 other EU waste directives...!

THE WEEE DIRECTIVE

- Producer responsibility
- Reduce the waste from electrical and electronic equipment
- Increase recovery and recycling rates of WEEE
- Improve environmental performance of all operators involved in the life cycle of WEEE
- Encourage separate collection and treatment of WEEE
- Private householders may return WEEE free of charge

THE WEEE DIRECTIVE

- 10 categories of WEEE
- UK Law by 13th August 2004 – separate WEEE collection/producer registration
- Compliance by August 2005
- Targets to be achieved by Dec 2006
- Collection target
 - 4kg/head of population
- Recovery & recycling target
 - 70-80% recovery, 50-75% recycle
- Revised targets by Dec 2008

WHO IS AFFECTED ?

WEEE Directive has implications for:

- Product manufacturers
- Component manufacturers
- Importers
- Retailers
- Local authorities
- Consumers

WEEE CATEGORIES

- WEEE divided in 10 categories
 - depending on size
 - depending on recycling method
 - depending on content of substances
 - depending on origin

1	2	3	4	5
6	7	8	9	10

WEEE CATEGORIES



large household appliances

- refrigerators
- washing machine
- micro waves
- electric heater
- others

1	2	3	4	5
6	7	8	9	10

WEEE CATEGORIES

small household appliances

- vacuum cleaner
- irons
- toaster
- tooth brushes
- others

large household	2	3	4	5
6	7	8	9	10

WEEE CATEGORIES

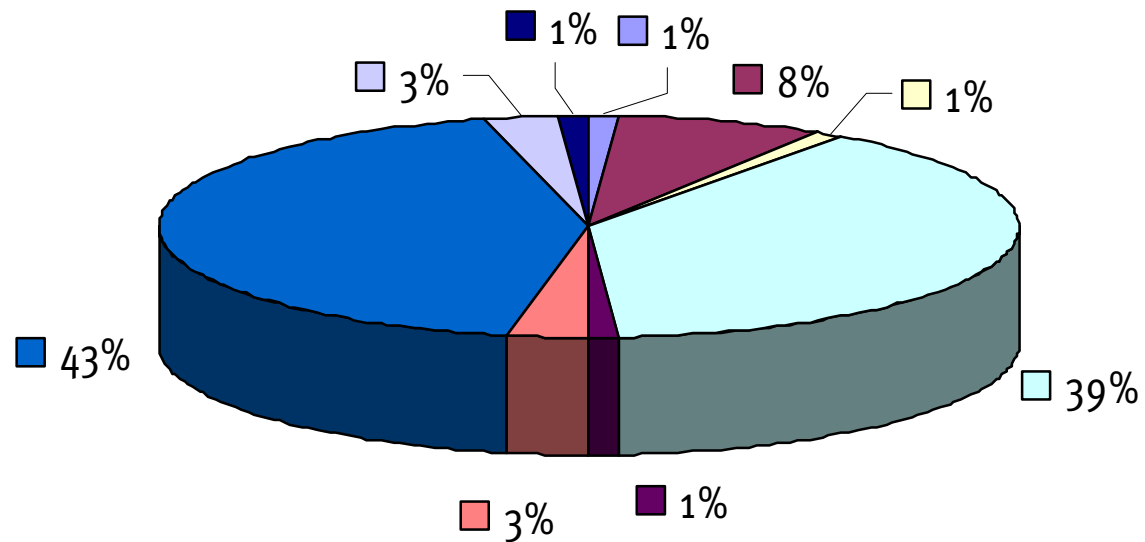
automatic dispensers

- for hot drinks
- for hot and cold bottles and cans
- for solid products
- others

large household	small household	IT & telecom.	consumer equipment	lighting equipment
electr. tools	toys	medical equipment	monitoring instruments	10

WEEE DISTRIBUTION

165 million items -> 915,000 tonnes of Electr(on)ic waste per year in UK



Lighting	Audio & Visual
Telecom	ICT Equipment
Toys	Small household appliances
Large household appliances	Tools
Instruments	



RECOVERY TARGETS

	1	2	3	4	5
	large household	small household	IT & telecom.	consumer equipment	lighting equipment
recovery	80	70	75	75	70
reuse and recycling	75	50	65	65	50
	6	7	8	9	10
	electr. tools	toys	medical equipment	monitoring instruments	automatic dispensers
recovery	70	70	to be defined within 5 years	70	70
reuse and recycling	50	50		50	50

exception
for gas discharge lamps, the rate of reuse and recycling should reach **80 %**

PRODUCER RESPONSIBILITIES

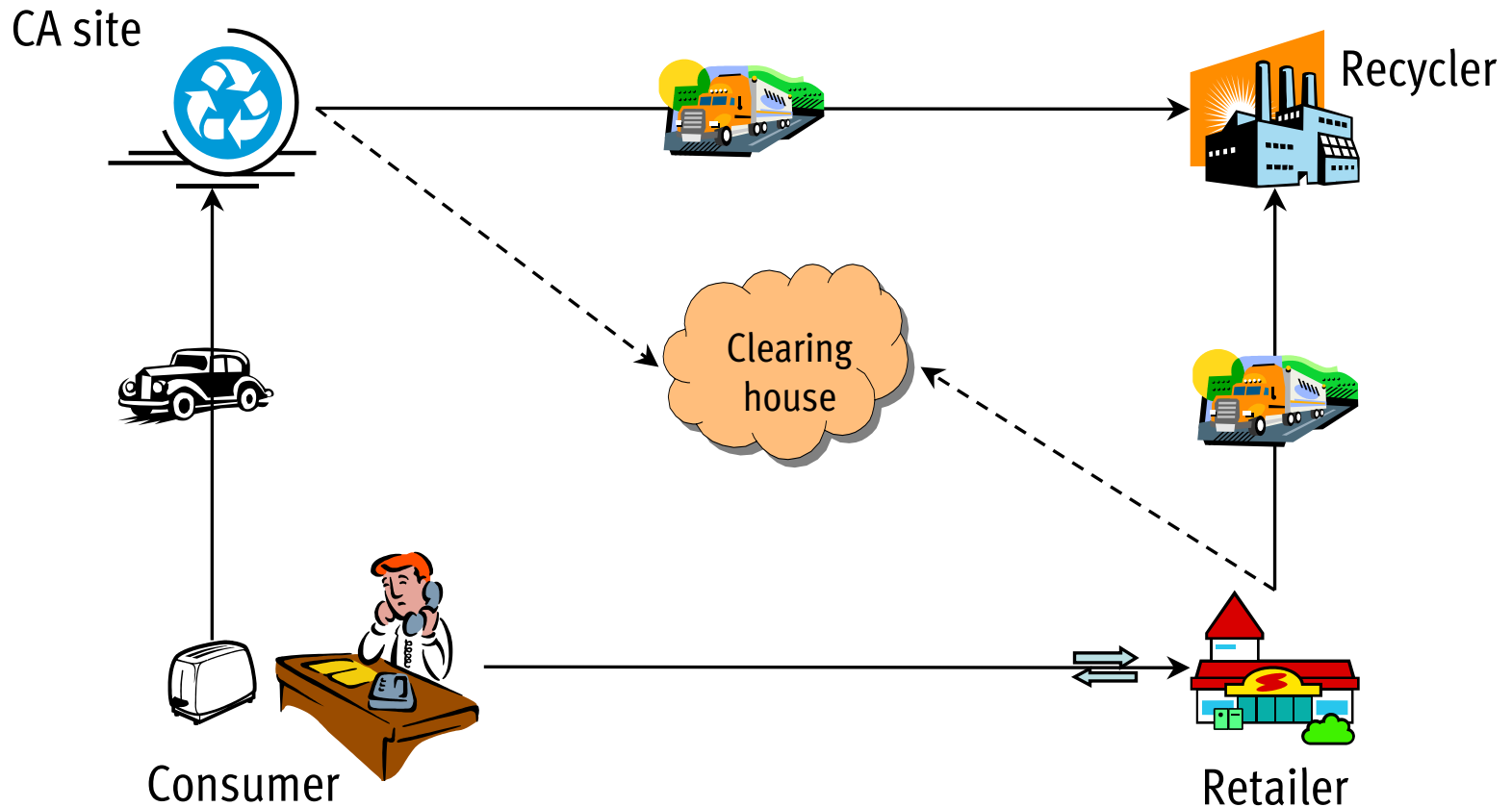
- Arrange collection, treatment, and recovery of WEEE from central collection points
- Ensure recovery/recycling targets are met
- Provide financial guarantees
- Registration as “producer”
- Provide data on sales to enable market share calculation
- Marking of equipment
- Provide information to facilitate product recycling



CLEARING HOUSE

- Managed by “producers”
- Administrative role
 - Allocation
 - Registration
 - Reporting
 - Monitoring
- Call centre model
- Ensure WEEE is collected
- Ensure compliance

WEEE RETURNS NETWORK



RoHS DIRECTIVE

- Phase-out the following by 1 July 2006:
 - Lead
 - Mercury
 - Cadmium
 - Hexavalent chromium
 - Polybrominated biphenyls (PBB) and
 - Polybrominated diphenyl ethers (PBDE)

Exemptions: medical devices, lamps, light bulbs etc

PACKAGING DIRECTIVE

- Producer responsibility
- “Packaging”
 - Primary/Secondary/Tertiary
- “Producers”
 - turnover > £2m + packaging > 50 tons/yr
 - all actors in the “packaging chain”
 - importers

PACKAGING DIRECTIVE

UK Packaging recovery targets

Material	2004	2005	2006	2007	2008
Paper	65	66	68	69	70
Glass	49	55	61	66	71
Aluminium	26	28	30.5	33	35.5
Steel	52.5	55	58	60	61.5
Plastic	21.5	22	22.5	23	23.5
Wood	18	19	20	20.5	21
Overall recovery	63	65	67	69	70



WEEE Compliance Case study - BT

Mr. Dennis Lockett

BREAK OUT SESSION 2

- In this session you will
 - Identify the WEEE category that your products fall into
 - Understand the recovery & recycling requirements imposed on your products by the WEEE Directive
- You will also
 - Think about what can be done to improve the lifecycle performance of your products
 - Design
 - Operations
 - Information



Solution approaches for effective PLM

Dr. Duncan McFarlane



BETTER DESIGN

- Design for Maintenance (DfM)
 - Interchangeable spare parts, etc.
- Design for Recycling (DfR)
 - Use recyclable materials, avoid different types of plastics, reusable packaging, etc.
- Design for Disassembly (DfD)
 - Modular design, non-permanent joints, snap-fit, etc.
- Design for Environment (DfE)
 - Eliminate “hazardous” materials



IMPROVED USAGE

- Longer Life
 - Promote upgrades and regular maintenance
- Educate consumers
 - Innovative ways to share information about optimum operating conditions, etc.
 - To prevent misuse of products
- Collect crucial lifecycle usage data
 - Can be used for better design of future models
 - Can be used to make better product recovery decisions



BETTER EOL MANAGEMENT

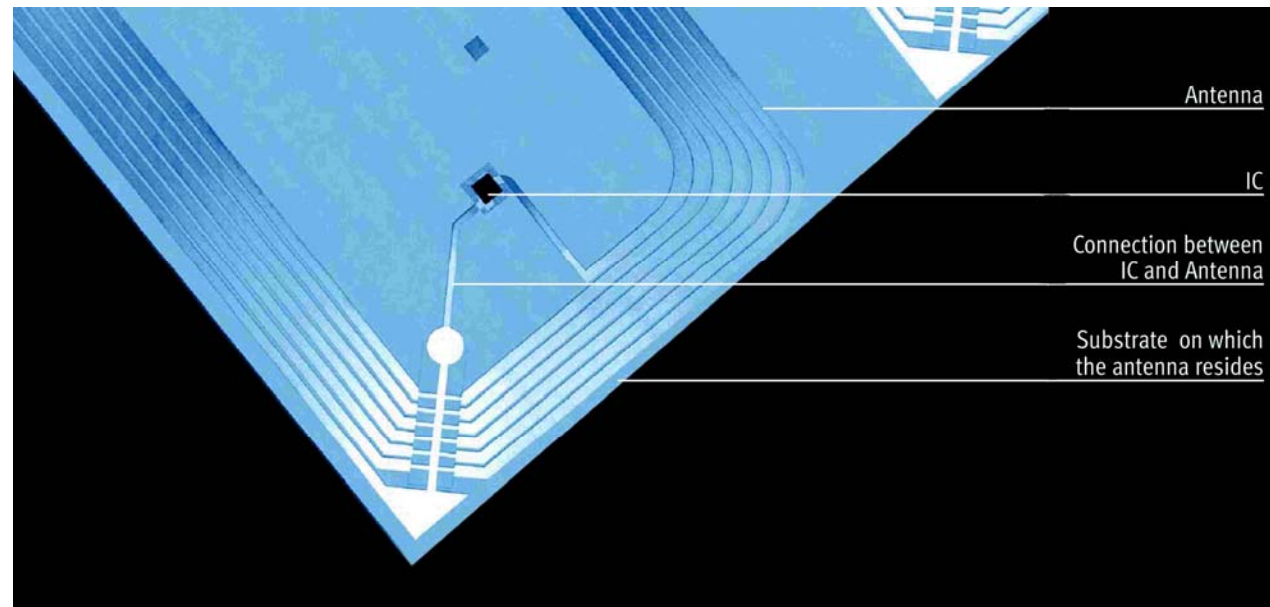
- Develop relationships with recyclers/
remanufacturers
- Develop an EOL “strategy” for your products
- Conduct Life Cycle Analysis (LCA) for your
products - **Environmental footprint**
- Identify information requirements for recovery
decisions
- Share product information
- Develop and share disassembly “recipes”

SUPPORTING INFORMATION REQUIREMENTS FOR EOL MANAGEMENT

- Need to identify products at end-of-life
 - RFID is obvious choice as data carrier
 - EPC is obvious choice as data content
- Need more than identity, however
 - Associated information about the product design
 - Data on use of product through it's life – e.g. servicing
 - This is what the EPC Network supports

AUTO-ID TECHNOLOGY BUILDING BLOCKS: 1

- Radio Frequency Identification
 - Tags and Readers
 - Radio has benefits over barcode
 - Cost is critical





AUTO-ID TECHNOLOGY BUILDING BLOCKS: 2

- The Electronic Product Code (EPC)
 - *Unique* number stored in RFID tag
 - Associated info stored in network
 - Scalable and extensible

01.0000A89.00016F.000169DC0

Header
0-7 bits

EPC Manager
8-35 bits

Object Class
36-59 bits

Serial Number
60-95 bits

AUTO-ID TECHNOLOGY BUILDING BLOCKS: 3

- Physical Mark-up Language (PML)
 - Used for describing physical objects – classification and categorisation
 - describing events, operations etc.

```
<?xml version="1.0" encoding="UTF-8"?>
<BatchOrder>
  <Owner>
    <Role> manufacturer </Role>
    <Entity> Tesco </Entity>
  </Owner>
  <Date label="deliverby">0</Date>

  <Future>
    <Config label="c1">
      <Msr q="1">3</Msr>
      <Price>70</Price>
      <Date label="edited">1038334977000</Date>
      <Part label="box" epc="0000000A1000002000000000">
        <Part label="item1" epc="00000000100000A000000000"/>
        <Part label="item2" epc="00000000100000B000000000"/>
        <Part label="item3" epc="00000000100000D000000000"/>
      </Part>
    </Config>
```

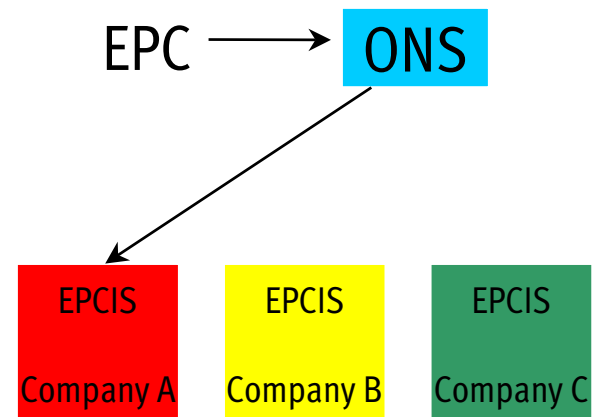
AUTO-ID TECHNOLOGY BUILDING BLOCKS: 4

Storage of 'EPC-related' data	
Time stamped event data	Attribute data (often static)
Observations (Tag readings)	Attributes defined at serial level e.g.: date of manufacture, expiry
Measurements (Sensor data)	
Symbolic location/containment	Attributes defined at product level e.g.: mass, dimensions
EPC <-> transaction ID	

- EPC Information Service
 - Networked database
 - Interface w/ existing data sources
 - Registry for event information
 - Query support

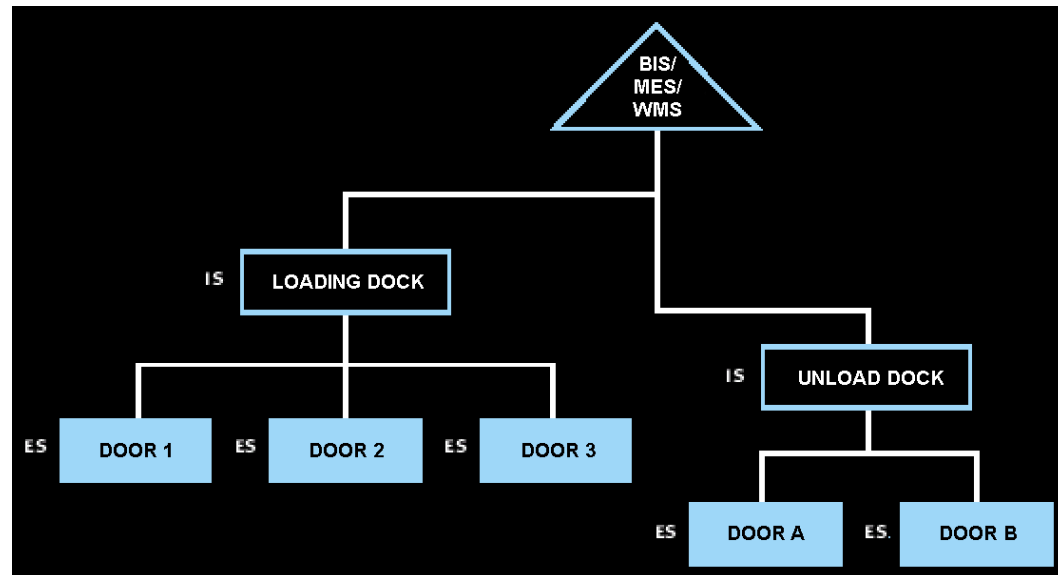
AUTO-ID TECHNOLOGY BUILDING BLOCKS: 5

- Object Naming Service (ONS)
 - Redirection service
 - Telephone book
 - Similar to DNS, with additions

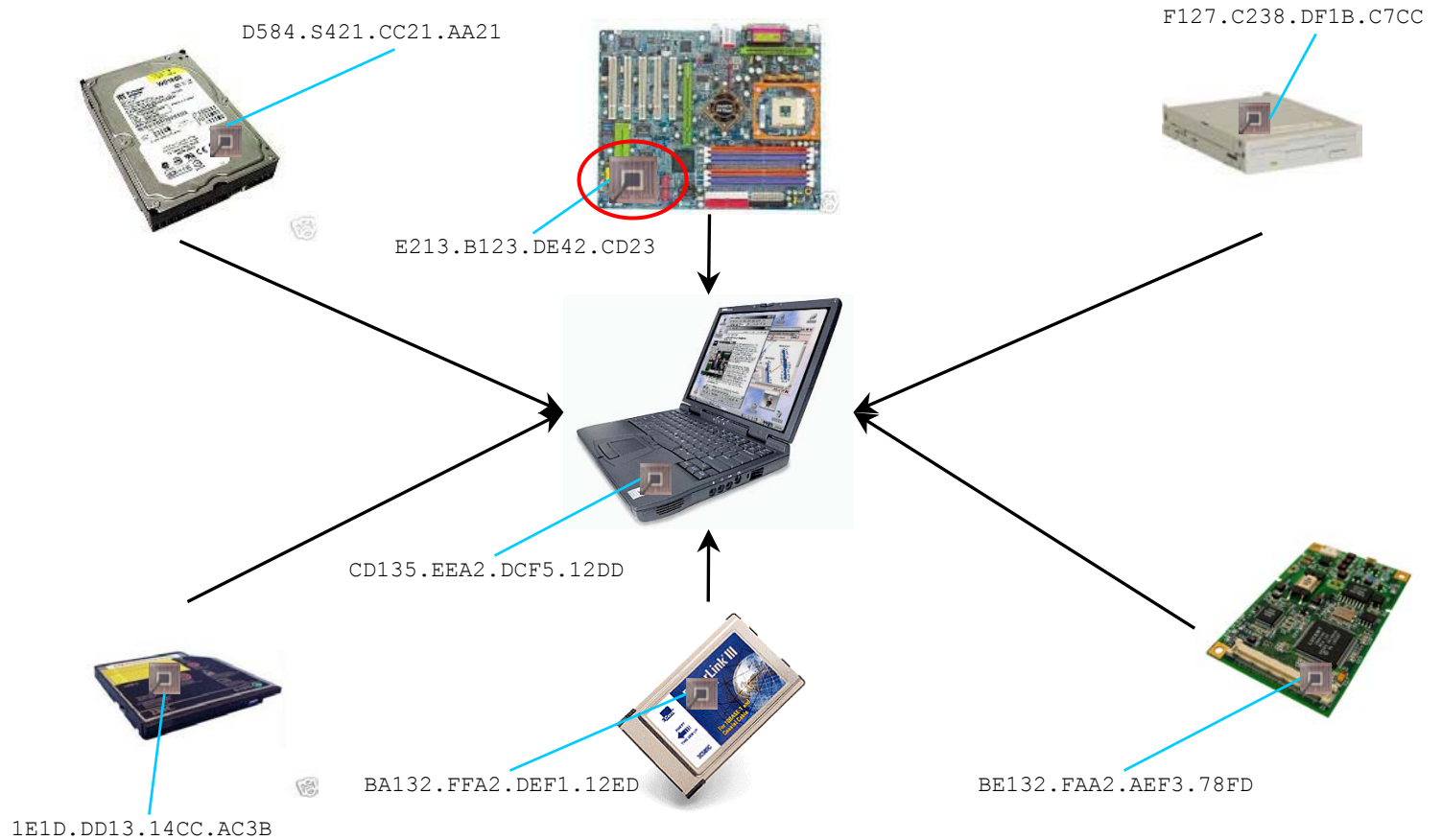


AUTO-ID TECHNOLOGY BUILDING BLOCKS: 6

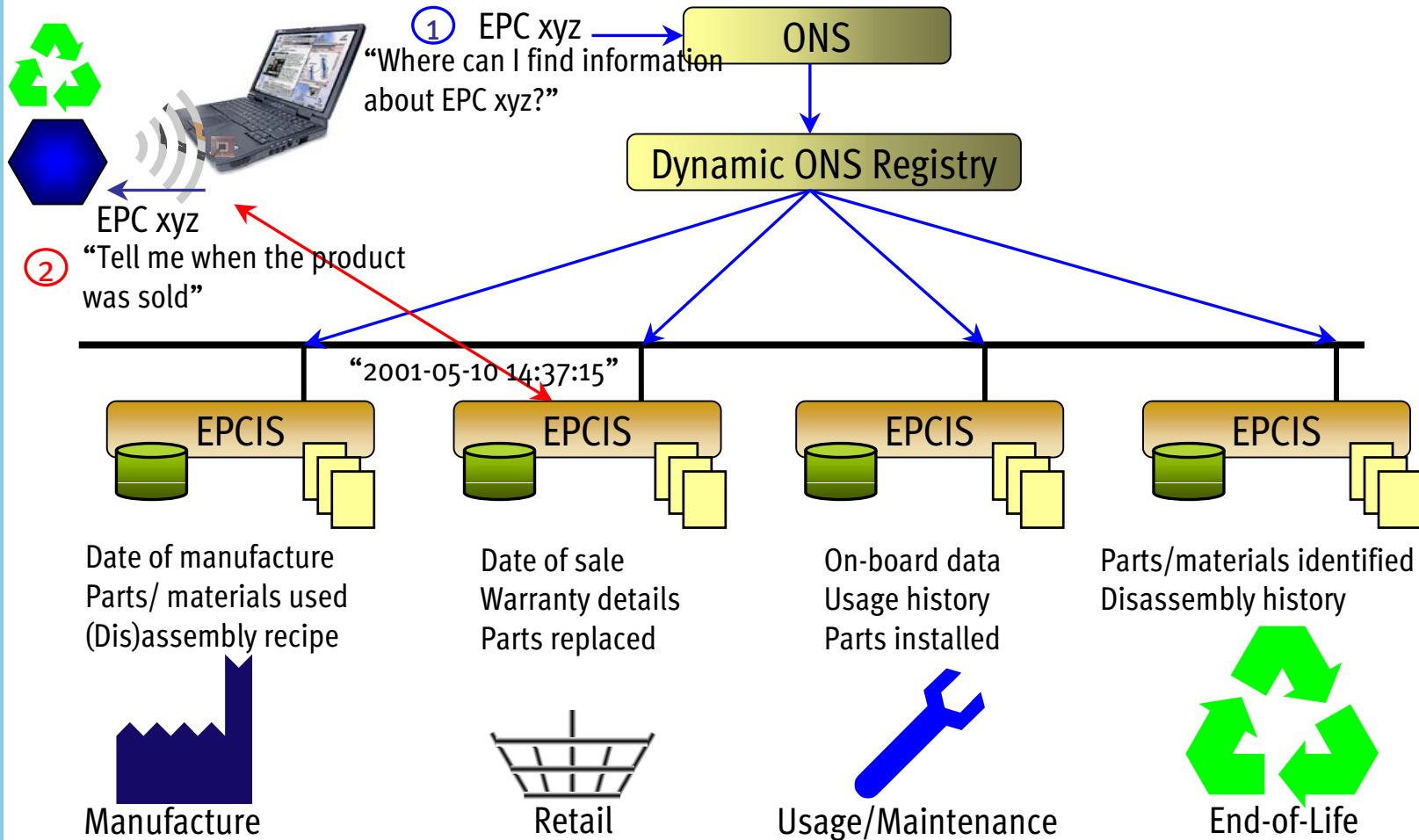
- Savant
 - Collects and filters RFID 'blips'
 - Generates higher level events
 - Provides common interface



EPC™ BASED PLM



EPC™ BASED PLM



BENEFITS

- Collection
 - Quick and possibly automated identification & sorting
 - Accurate accounting & compliance documentation
- Recycling
 - Identification of hazardous substances used in design
 - Better estimation of recyclable material content
- Reuse & Remanufacturing
 - Faster and accurate product identification
 - Better estimation of residual life and value
 - Rich information leads to better decisions → higher rate of reuse
- Product Design (Manufacturers)
 - Better future product designs (Environment friendly, Re-use friendly, Recycle friendly, etc.)



Thank You

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<http://www.ifm.eng.cam.ac.uk/cdac>