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Master of Science in Strategic Market Creation

Master's Thesis

Strategies for Reverse Supply Chains in the Personal Computers Industry

How Dell and HP manage a dual business model comprising the forward supply chain of brand new PCs and the reverse supply chain of end-of-life PCs

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Abstract

The study explores how organizations competing in the personal computers (PCs) industry can manage a dual business model comprised of the forward supply chain of brand new products and the reverse supply chain of end-of-life (EOL) equipment, in order to maximize their profitability and supply chain efficiency. As a consequence of the WEEE directive, which became law in 2003 in Europe, producers of electrical and electronic equipment are responsible for recovering the used products in a responsible way from final consumers. The law, which has been approved also in other non-European countries like US, China and South Korea, has brought several challenges to firms in the PCs industry when dealing with the new business model. Moreover, in the logistics literature the topic has not been sufficiently deepened, resulting in confusion for both companies and researchers on how to simultaneously manage the two businesses in the most efficient way.

Through a dual case study involving two of the leaders in the PCs industry, Dell and Hewlett-Packard (HP), the research explores the strategies implemented by the two companies for managing the dual business model and compares them based on their performance on selected indicators affecting the ROA. The study provides evidence that it is possible to succeed in the PCs industry not only by adopting a pure outsourcing strategy, as HP did, but also by following the example of Dell and internalizing some reverse supply chain activities. The research can therefore be viewed as an attempt for demonstrating companies in the electronic industry and researchers in the logistics and strategic literature that there are possibilities for handling reverse supply chain activities within the organizational structure. Moreover, it can represent a starting point for deepening the topic with the goal to identify a best-practice approach for companies in the electronic industry when managing the dual business model of forward and reverse supply chain.

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1. Introduction

1.1. Theoretical background of the research

In the stable industrial economy, enterprises used to operate a single business model in a particular industry. However, in the current fast-changing economy, mainly driven by advanced technology, knowledge-networking, and globalization, the resulting socio-techno-economic environment is one that challenges the essence of relatively stable business models that firms used to achieve their particular goals (Davenport, Leibold, & Voelpel, 2006).

Especially external forces to the industry can shape the competitive environment of a company, in fact managers have to be able to foresee potential disruptive factors such as political, economic, social, technological, environmental and legal forces that might affect the industry and shape it (Gillespie, 2007). These driving forces have created substantial uncertainty in the competitive landscape by bringing about fundamental changes in the traditional boundaries of nations, industries and companies (Davenport et al., 2006). Companies need therefore to adapt, integrate and re-configure internal and external skills, resources and functional competencies towards a changing environment (Teece & Pisano, 1994). This process of constant modification and development of innovation capability is the essence of what strategists call "dynamic capability" (Teece, Pisano, & Shuen, 1997). However, this does not mean that a traditional business model should be closed down, but rather that companies should be open to embrace new business models and manage them simultaneously with the old ones. As a consequence, companies need an orientation towards, and a capability of, having a portfolio of business models, rather than having a singular focused strategy based on one business model (Davenport et al., 2006). Nonetheless, companies usually try to resist to new business models, not only because these sometimes require the cannibalization of the traditional business, but also because the disruptive innovation brings radical and challenging changes to the organization which on the other hand is often characterized by routines and commitment to the traditional business model.

1.2. Practical background of the research

An example of the situation mentioned before is well depicted by the current competitive scenario in the global personal computers (PCs) industry. The PCs industry, with its 295.8 million units sold in 2011, a number expected to rise to 431.0 million units by the end of 2016 (Datamonitor, 2011), represents a growing industry in the electronic market. However, since the PCs industry is growing at an exponential rate with continuous innovations able to reach the market in a very short time, combined with a continuous improvement of the technology, it leads to a quick obsolescence of products (Grenchus, Johnson, & McDonnel, 2001). The computer's product life cycle has in fact

drastically reduced and the useful life of a PC is now in the sub-three year range (Greene, 2000). Thus, shrinking of the useful life of computers has resulted in an ever-increasing amount of end-of-life (EOL) computers being disposed of. Moreover, while customers have benefited from greater product variety and enhanced performance, it has resulted in an increase in unsold products, packaging materials and waste (Van Hoek, 1999). Electronic waste has therefore become a growing concern in computer hardware supply chains since discarded computers contain hazardous wastes, which if directly dumped into landfills or improperly recycled could pose serious hazard to human health and the environment (LRQA, 2012).

Notwithstanding the problems caused by electronic waste, this has not resulted in efficient take-back programs for the recycling of EOL computers; in fact as stated by the US Environmental Protection Agency (EPA, 2011), 47.9 million of computers were ready for end-of-life management in 2009 in the US, but only 18 million of them (38%) were collected for recycling.

As a consequence, several regulations affecting producers of electrical and electronic equipment (EEE) have been worldwide approved for facing the problem of increasing electronic waste. European Union is leading the way by developing environmental-friendly regulations, such as Waste Electrical and Electronic Equipment (WEEE) Directive and Restriction of Use of Certain Hazardous Substances (RoHS) Directive, focused on preventing and managing waste streams, which in turn have affected the way companies in the computer industry are conducting their businesses.

The WEEE directive, which became European Law in February 2003, applies to all equipment that can be plugged into an electrical circuit or that operates on batteries. It includes large and small household appliances, information technology and telecommunications equipment, lighting equipment, electronic tools, toys and sports equipment, some medical devices, monitoring and control instruments (Kumar & Putnam, 2008). The WEEE Directive makes manufacturers and domestic importers/distributors responsible for taking electrical and electronic waste back from consumers in an environmentally friendly manner (Skyott-Larsen, Schary, Mikkola, & Kotzab, 2007).

RoHS (EU Directive 2002/95/EC) was published as a companion to the WEEE directive and they are applied together. The RoHS bans the use and placing on the market of certain hazardous heavy metal including lead, mercury, aluminum, cadmium, chromium and brominated flame-retardants in new electrical and electronic equipment after 1 July 2006 (US Commercial Service, 2005).

Also in Asia some regulations have been developed for facing the e-waste issue. China and Korea have in fact followed EU in promulgating regulations to manage electronic equipment waste, in order to ensure its electronic exports can compete globally. Statistics released by the China Electronics Import & Export Corporation estimate that 70% of China's electronics exports will be impacted by WEEE and RoHS requirements (Hicks, Dietmar, & Eugster, 2005).

Moreover, so far in US 25 states have passed legislation mandating statewide e-waste recycling. All laws, except for California and Utah, use the producer responsibility approach, where the manufacturers must pay for recycling. This means that 65% of the population of the US is now covered by a state e-waste recycling law (Electronics Take Back Coalition, 2012b).

As a result of regulations, corporate and customer awareness, competition, marketing and economic motives, computer companies have initiated reverse logistics activities in their organizations (Ravi, Shankar, & Tiwari, 2007). Companies in the computer industry have therefore faced the problem of managing two different business models: the traditional one, which consists in manufacturing and selling PCs, and the new business of the return flow of EOL products from the final customer to the manufacturer. The return flow of EOLs needs however to be distinguished from the one of the products returned for end of leasing, commercial returns, demos and production surplus since these might be treated differently by the PCs companies.
As a matter of fact, there is still some confusion in the industry on how to deal with the new business, in fact, while some computer manufacturers are directly handling the reverse supply chain, others have preferred outsourcing the reverse supply chain activities to third-party reverse logistics providers due to their inability to effectively integrate the two business models of the company.

1.3. Research question

Through an analysis of the strategies implemented by two of the leaders in the PCs industry, Dell and Hewlett-Packard (HP), for managing their forward and reverse supply chains, the thesis will try to answer to the following research question:

RQ: How can companies in the PCs industry effectively manage a dual business model consisting of the forward supply of new products and the reverse flow of EOL computers in order to maximize their supply chain performance?

The Du Pont model (Appendix 4) is utilized for identifying how supply chain decisions have an impact on several key performance indicators (KPIs) affecting the profitability and asset turnover efficiency of companies.

1.4. Reasons for choosing the topic

The case has been chosen due to my interest in the reverse logistics topic and to the challenge that it represents for companies involved with the PCs industry. In fact, I believe that a proper management of the reverse supply chain could provide benefits both to the companies, by assuring a sustainable and difficult to imitate competitive advantage, and also to the society, by providing environmental benefits to people and to the planet through environmental friendly e-waste recycling processes.

Notwithstanding this, many companies still view the reverse supply chain more as a threat for the mainstream business rather than an opportunity for higher profits and better corporate image. Thus, my objective is to provide evidence to companies involved with the returned of used products of the benefits gained by an effective management of their reverse supply chain.

1.5. Structure of the thesis

The thesis has been structured in seven sections. After having defined the background of the research in the introduction part, in the second section, an overview of the theories, both in the strategic and in the logistic literature, for how to manage a dual business model is presented. In the third chapter, the methods adopted for conducting the research study, including a presentation on how data have been collected and analyzed, are discussed. The fourth section contains a detailed description of the forward and the reverse supply chain for both Dell and HP. Firstly the general structure of each chain is depicted, and afterwards every player in the chain is described both in terms of its configuration and also in terms of the strategies adopted by Dell and HP for dealing with the player. In chapter five the findings of the research study are presented. First, an analysis of the effectiveness of supply chain decisions of the two companies is conducted by comparing the performance of Dell and HP on selected KPIs affecting the return on assets of the two companies. Afterwards, the strategies adopted by Dell and HP for managing the dual business model are defined based on the theories identified in the literature. In section six, the conclusions of the study are presented and recommendations for companies involved with the PCs industry are provided. Finally, in chapter seven, a critical refection of the research study is exhibited and recommendations for further research are suggested.

2. Theoretical background of the strategies for managing dual business models with a focus on reverse supply chain in the PCs industry

A literature review is summarized below in order to understand the current state of the theories focusing on the strategies available for companies when adopting a dual business model consisting in the forward and reverse flow of products. Firstly, a common definition of "business model" is identified in order to present an overview of the different schools of thought in the strategic literature on how to manage multiple business models. Afterwards, the research is narrowed to the field of reverse logistics for emphasizing the need for companies in the electronic industry to manage a dual business model consisting in the management of the forward and reverse flow of products. Hence, based on the strategies identified for managing dual business models, an overview of different schools of thought in the logistics literature on how to simultaneously managing the forward and reverse supply chains is presented.

2.1. Definition of "business model"

In the business literature many authors have tried to define what a business model is.
Slywotzky (1996) argued that a business model consists of the decisions that a firm makes on eleven dimensions: fundamental assumptions about the business, customers selected, scope of activities, source of differentiation, value recapture, purchasing system, manufacturing system, capital intensity, R&D and product development system, organizational configuration and go-to-market mechanism.
Schmid, Alt, Zimmermann, & Buchet (2001) instead distinguish six generic elements of a business model: mission, structure, processes, revenues, legal issues, and technology.
According to Viscio & Pasternack (1996), a business model comprises the following five elements: global core, business units, services, governance, and linkages.
Synthesizing these views, a business model can be defined as the particular business concept as reflected by the enterprise's core value proposition for customers; its configured value network to provide that value, consisting of own strategic capabilities as well as other value networks and capabilities; and its leadership and governance enabling capabilities to continually sustain and reinvent itself to satisfy the multiple objectives of its various stakeholders (Davenport et al., 2006).
Therefore, a business model consists in the sum of the answers that a company gives to the following interrelated questions (Abell, 1980):

- Who should I target as customers?
- What products or services should I be offering them and what should be my value proposition?
- How should I do this in an efficient way?

2.2. Strategies for managing dual business models

In stable industries enterprises usually operate a single business model, however in dynamic environment firms face the challenge of keeping up with the constantly changing business paradigm. As stated by Christensen (1997) and Hamel (2000), competition in the contemporary world is in fact no longer between products or services but between competing innovation regimes, business concepts or business models. Companies need therefore to be open to new business models and embrace them without destroying their existing ones.

In the business literature the discussion on how to manage dual business models has often resulted in an internalization option, consisting either in a separation solution or an integration one. However, recently some authors have suggested to adapt a contingency approach rather than an either/or perspective. Moreover, also the outsourcing strategy has been presented as an alternative for managing new business models in the early stages of their development.

The theories of the authors supporting the different alternatives are briefly presented.

2.2.1. Outsourcing strategy

The outsourcing strategy is not widely discussed in the strategic literature as an option for cultivating new business models, since it is considered to be comparable to the decision of not embracing the new business model. As a matter of fact, the outsourcing strategy is only deemed as a valuable opportunity for some activities of the firm where the company's ability to perform them is fairly low and thus, by externalizing them, the organization can both reduce the costs for managing them and also improve the quality associated to them (Gottfredson, Puryear, & Phillips, 2005).

However, Markides & Geroski (2005) recently suggested an outsourcing strategy for managing new business models by partnering with sub-contractors. The authors propose large corporation to act as venture capitalists for small, start-ups companies in new markets, and then, when it is time to consolidate the market, established firms can build a new mass-market business on the platform of the young companies by acquiring them.

2.2.2. Separation strategy

In the strategic literature, a primary solution offered by scholars on how to solve the problem of managing dual business models, is to keep the two businesses physically separate in two distinct organizations owned by the established company. By keeping the two businesses separate, a company can prevent its existing processes and culture from suffocating the new business model while the new unit can develop its own culture, processes, and strategy without interference from the parent.

According to Michael Porter, the challenge with attempting to manage two different business models in the same market is that the two models could conflict with one another due to the trade-offs existing between them (Porter, 1980). To Porter, a new business model requires a new combination of tailored activities specifically designed for competing effectively in the newly created market. These new activities will be incompatible with the company's existing set of activities as a result of the trade-offs that exist between the two alternative strategic positions. Therefore, Porter suggested creating stand-alone units, each with its own brand name and tailored activities (Porter, 1996).

Also Bower & Christensen (1995) supported the separation strategy as solution for business-model innovations. As stated by the authors, in order to commercialize and develop new technologies, managers must protect them from the processes and incentives that are geared to serving established customers. They also added that the only way to protect them is to create organizations that are completely independent from the mainstream business. In fact, when the independent and mainstream organizations are folded together in order to share resources, debilitating arguments arise over which groups get what resources and whether or when to cannibalize established products.

Finally, Utterback (1994) argued that established firms can gain a foothold in markets generated by a radical technological innovation by setting up autonomous, independent units to exploit the organizational flexibility and entrepreneurial spirit that are required to succeed in the new environment (Markides, Game-Changing Strategies, 2008).

2.2.3. Integration strategy

An alternative school of thought suggests that the new business model should not only be internalized by the company, but also integrated within the current organizational structure, in order to gain synergies between the two units.

Smith, Binns & Tushman (2010) stated that the long-term success of an organization depends on its capability to manage paradoxical strategies simultaneously. These consist in multiple strategies that are 'contradictory, yet interrelated' (Lewis, 2000). They involve contradictory or inconsistent products, markets, technology or associated resources, yet they both may be necessary for long-term organizational success and, in fact, they can reinforce one another. In order to manage the tension between the multiple strategies, the authors recommended integrating them into the same firm and mitigating the tension by employing leadership teams capable of developing the kind of models required to embrace and support the paradoxes simultaneously. To manage paradoxical strategies effectively, leaders must be capable of communicating an overarching vision, building and maintaining

organizational designs that are internally inconsistent, managing ongoing conflict and engaging in long term, integrative thinking.

Also Lewis (2000) stated that paradoxes, when effectively managed, can bring long-term success to companies. Managers need in fact to recognize, become comfortable with, and even profit from tensions and the anxieties they provoke. Yet, the author argued that managing paradoxical tensions denotes not compromise between flexibility and control but awareness of their simultaneity. Therefore the author supported the integration strategy between different business models since staying with the paradox makes it possible to discover a link between opposing forces and opens up the framework that gives meaning to the apparent contradictions (Vince & Broussine, 1996).

2.2.4. Contingency perspective

While the separation strategy lets the companies avoid conflicts between the two business models, it also prevents them from gaining synergies between the organization and the separated business unit. The other way around, integration allows companies to gain synergies between the two units but it might cause conflicts and trade-offs between the two businesses. As a consequence, some authors emphasize the need to adopt a contingency perspective instead of an either/or approach when evaluating how to effectively manage a dual business model.

Cooper & Smith (1992) adopted this perspective after conducting a study on how established firms responded to various threatening technological innovations. The authors argued that by adopting an integration strategy companies can often gain synergies from utilizing the existing organization for the new product. However, by considering this strategy, management should recognize that decisions concerning the new product will take place within an administrative system and culture that is attuned to competition in the established industry, and the needs of the traditional business. Moreover, management should be especially sensitive to the problem of divided loyalties that may result if the existing organization is used, and of the constraining effect that this may have upon the firm's actions in the young industry. On the other hand, if the decision is made to create an independent unit for the new product, senior managers should recognize that a high level of sponsorship and protection on their part may be required for this arrangement to succeed. The authors concluded that there is no easy answer to the question on how to organize the new business and therefore the choice is company specific.

Gilbert & Bower (2002) in their article “Disruptive change: when trying harder is part of the problem” proposed a modular approach for dealing with two business models. The authors recommended separating the new business model from the organization at the intial stages of its development since

separated freestanding ventures are more likely to view the new business unit as an opportunity rather than a threat. Moreover, intervention by the core organization can result in an overemphasis on established business practices, which prevents the development of ones that are more appropriate to the new market. The authors stated in fact that "if a single, integrated organization tries to sustain a still-viable business model while simultaneously trying to develop a new platform for growth, it gets pulled in two directions, and both efforts underperform. The solution is therefore to separate the two businesses at the beginning, however, over time, as the new technology is improved to permit the new business to move up-market, there may be increasing opportunities in a number of functional areas to leverage resources between the old and new businesses" (Gilbert & Bower, 2002).
This however can only be possible if in the company exists an integrator who helps facilitate the process by managing the tensions between the parent and the new venture. When the new venture needs access to the parent's resources, the integrator can prompt the parent's response by instilling an active sense of threat in the core organization. By the same token, when the core organization seeks to focus the venture's considerations on the existing business, the integrator can intercede and protect the new unit. What is important is however that the integrator has high credibility in both organizations. In conclusion, the authors believe that a modular approach to integration can leverage exisiting synergies without damaging the independent work process in each organization.

Finally, Markides (2008) supported the contingency perspective in his book "Game-Changing Strategies", where the author examined the introduction of new business models in a number of American industries and studied how established companies responded to them. As a result of the study, the author identified four possible strategies for managing a dual business models, based on two main criteria:

- How serious the conflicts between the two businesses are – because this determines whether a separation strategy would be especially beneficial or not
- How strategically similar the new market is perceived to be to the existing business – because this determines how important the exploitation of synergies between the two will be

The four strategies identified for managing a dual business model have been:

- *Separation:* it is the preferred strategy when the new market is not only strategically different from the existing one but also has serious trade-offs and conflicts with the established market. By keeping the two business models separate, a company can prevent its existing business processes and culture from suffocating the new business model. The new unit can develop its own culture, processes, and strategy without interference from the parent organization. It can

also manage its business as it sees fit without being suffocated by managers of the established company who often see the new unit as a cannibalization threat.

- *Integration:* this strategy is recommended when the new market is very similar to the existing business and presents few conflicts that need managing. This way, the company can exploit synergies among the two businesses, such as the sharing of assets, resources, and knowledge.
- *Phased integration:* when the new market is strategically similar to the existing business, but the two face serious conflicts, a phased integration strategy might be recommended, by separating for a period of time and then slowly merge the two concepts so as to minimize the disruption from the conflicts.
- *Phased separation:* this strategy is advised when the new market is fundamentally different from the existing business, but the two are not conflicting in a serious way. In such a case, it might be better to first build the new business inside the organization so as to leverage the firm's existing assets and experience (and learn about the dynamics of the new market) before separating it into an independent unit.

2.3. Reverse logistics, a new business model for European computer manufacturers

While a prerequisite of the different theories previously summarized is that a company can autonomously decide whether to embrace a new business model or not, and afterwards decide which strategy is the most suited for managing it; companies competing in the PCs industry, especially in Europe, have been obliged by legislation to deal with the new business model of reverse logistics, as opposed to the traditional forward flow of final products.
The new business refers to the process of planning , implementing and efficiently controlling the flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin with the purpose of recovering the primary value or dispose of them properly (Rogers & Tibben-Lembke, 1999). The new business differs significantly from the traditional one of the forward supply chain; in fact it comprises the following activities that need to be managed by the company (Guide, Harrison, & Van Wassenhove, 2003):

- *Product acquisition*: to obtain the products from the end-users
- *Reverse logistics*: to move the products from the points of use to a point(s) of disposition
- *Testing, sorting, and disposition*: to determine the product's condition and the most economically attractive reuse option

- *Refurbishing*: to enable the most economically attractive of the options (direct reuse, repair, remanufacture, recycle, or disposal)
- *Remarketing*: to create and exploit markets for refurbished goods and distribute them.

These activities are outlined in the model presented by Knemeyer, Ponzurick & Logar (2002) in Appendix 2. The model, which specifically relates to the reverse supply chain of EOL computers, also highlights how external factors to the PCs industry, such as competitive and regulatory forces, can affect the decision undertaken for the reverse logistics activities.

2.4. Strategies for managing the dual business model of forward supply chain and reverse supply chain

As emphasized in the model of Knemeyer et al. (2002), regulatory factors assume a relevant influence in shaping the reverse supply chain activities. In fact, as previously stated, companies competing in the PCs industry have been obliged by law to handle the business model of the return flow of EOL PCs, and this has provoked some confusion for PCs companies when deciding how to deal with the two businesses simultaneously. Few companies have in fact embraced the new business in an active manner; instead many firms consider the reverse supply chain as a series of fairly independent and isolated activities.

This is also due to a lack of theoretically grounded and holistic view of reverse logistics, as stressed by Carter & Ellram (1998). Few authors have in fact tried to define a strategic framework for dealing with the dual business model of forward and reverse supply chain. The majority of the authors who approached the issue have recommended an outsourcing strategy for reverse supply chain, due to the inability of most companies to take charge of it. On the other hand, some authors have supported the internalization of reverse supply chain within the current organization through a separation strategy or an integration one without however explaining how to implement it. Finally, some authors have considered a contingency perspective when choosing the right strategy for managing the reverse supply chain business model, by stating that the final choice is industry specific. The different approaches are presented below.

2.4.1. Outsourcing strategy

Di Maggio (2000) emphasized the need for managers to decide whether to outsource their return processing or to manage them internally. The author identified the closeness to customers and the safeguard of customer's private data as advantages for the internalization of the reverse supply chain activities. Nevertheless, Di Maggio highlighted the risk to defocus the organization from the forward

supply chain, which is the core business of the company. As a consequence the author suggested separating the reverse supply chain from the core business and outsourcing it to TPL providers.

In a study conducted by Rogers & Tibben-Lembke (1999) by interviewing more than 150 managers responsible for reverse supply chain activities, the authors found evidence of the advantages of outsourcing reverse supply chain activities instead of managing them internally. As stated by the authors, returns have in fact a lower impact on the profitability of those firms utilizing outsourced centralized return centers (CRC) than those not using outsourced centralized return centers. Companies that used an in-house CRC found that reverse supply chain costs reduced profitability by 4.8 percent, while those companies that used a third party to manage their CRC found profitability reduced by 3.7 percent.

2.4.2. Separation strategy

Rogers & Tibben-Lembke (1999), besides favoring the outsourcing strategy for reverse supply chain activities, studied the advantages of internally managing the forward supply chain and the reverse supply chain in an integrated way, compared to managing them separately. The authors discovered that many distribution centers that attempted to process both forward and reverse supply chain flows in an integrated way had difficulties due to the management focus. In fact, if the distribution center manager had to make a choice between efficiently executing forward supply chain versus reverse supply chain, the manager would focus on forward distribution, since often returned products were perceived as failures of the company. The authors therefore supported the separation strategy for internally managing the reverse supply chain due to the lack of focus that managers would have on the reverse supply chain activities if the two businesses were integrated.

2.4.3. Integration strategy

Brennan, Gupta & Taleb (1994), highlighted the need to develop an integrated system incorporating existing assembly and disassembly scheduling methodologies into one scheduling and inventory system. However, the authors did not provide a solution for how to implement it.

Fleischmann (2000), besides arguing that the decision regarding the separation or the integration of the two business models cannot be generalized to every company but it is industry specific, stated that in the electronic industry the best strategy would be to integrate the two supply chains. This is due to the fact that the two chains are strategically similar, in fact geographical cost drivers are alike for the two channels, demand and return volumes are distributed along the same geographical patterns and forward and return flows correspond with each other. However, Fleischmann added that the forward

flows will, in general, dominate the optimal network structure since they are considered to be more important than return flows in terms of volumes, values, and time-criticality.

2.4.4. Contingency perspective

Serrato, Ryan & Gaytàn (2007) provided a model for deciding whether it was more convenient to perform the reverse supply chain activities internally or outsourcing them. By adopting the Markov decision model (Puterman, 2005) the authors defined a threshold above which it is optimal to follow an outsourcing strategy for the reverse supply chain system, otherwise to continue performing the reverse supply chain activities internally. However, the authors did not discuss how to strategically deal with the new business model once the decision of outsourcing or internalizing was made.

A comparison between the integration strategy and the separation one regarding the forward and reverse flow of products has been conducted by Fleishmann et al. (2001) by presenting two industrial cases. The authors concluded that by integrating the two channels, companies can benefit from a reduction of costs by sharing fixed assets, for example when installing a warehouse and a dissassembly center at the same location or when combining the distribution and collection activities by adopting the same transportation provider. However, even if combined, collection activities imply additional costs due to the use of additional resources (Beullens, Van Wassenhove, Van Oudheusden, & Cattrysse, 1999). On the other hand, separate networks have the advantage to be much easier to deal with organizationally. A company can in fact create a new, dedicated organizational unit to deal with return flows and as a result the cost of coordination and restructuring tends to be lower. Nevertheless, the authors did not state a preference for the separation or the integration approach, emphasizing that the decision is company-specific.

2.5. Conclusion on the current literature on how to simultaneously manage the dual business model of forward and reverse supply chain

A summary of the theories previously presented is exhibited in figure 2.5-1. In conclusion, in the strategic literature, the authors adopting the contingency perspective have tried to reconcile the advantages of the separation strategy with the ones of the integration one. In fact, they suggest to base the decision on how to manage a dual business model depending on the degree of conflictuality between the two businesses and the level of synergies that can be gained by integrating the two (Cooper & Smith, 1992; Gilbert & Bower, 2002; Markides C. C., 2008; Fleischmann, Beullens, Bloemhof-Ruwaard, & Van Wassenhove, 2001). Should the integration strategy be selected, companies need however to employ an integrator/facilitator to maximize the synergies between the two businesses while minimizing the conflicts between them (Gilbert & Bower, 2002; Markides C. C., 2008).

However, in the logistics literature most authors suggest companies to outsource the reverse logistics business due to the inability of companies to effectively manage its activities and due to the risk for companies to defocus their attention from the mainstream business (Di Maggio, 2000; Rogers & Tibben-Lembke, 1999). This is also due to the fact that organizations consider the reverse supply chain not as a profitable business but as costly activities that need to be handled because of legislation.

The logistics literature lacks therefore a framework for dealing with the forward and reverse stream of used products. The aim of this study is to understand how Dell and HP face this issue and then evaluate how their decisions affect their KPIs. This will let me better compare the advantages and disadvantages of different approaches for managing the forward and reverse flow of EOL PCs.

Figure 2.5-1: Overview of the theories presented in the literature review section

	Strategy Literature	Logistics Literature
Outsourcing strategy	▪ *Markides & Geroski (2005):* Partnering with small start-ups acting as venture capitalist	▪ *Di Maggio (2000):* Outsource for not defocusing the organization from the mainstream business ▪ *Rogers & Tibben-Lembke (1999):* Outsource for reducing the costs associated to reverse supply chain activities
Separation strategy	▪ *Porter (1980):* Create stand-alone units for avoiding conflicts and trade-offs ▪ *Bower & Christensen (1995):* Protect the new business from the processes and incentives of the established business by creating independent units ▪ *Utterback (1994):* Set up autonomous units for exploiting organizational flexibility and entrepreneurial spirit in the new business	▪ *Rogers & Tibben-Lembke (1999):* If the reverse supply chain is managed internally, separate it from the mainstream business due to the lack of focus that managers would have on it if integrated
Integration strategy	▪ *Smith et al. (2010):* Integrate the two businesses for managing paradoxical strategies by employing leadership teams ▪ *Lewis (2000):* Link opposing forces for simultaneously dealing with flexibility and control	▪ *Brennan et al. (1994):* Integrate assembly and disassembly scheduling methodologies into one scheduling and inventory system ▪ *Fleischmann (2000):* Integrate the forward and reverse supply chain in the electronic industry due to geographical similarities between the two chains in terms of cost drivers, demand and return volumes
Contingency perspective	▪ *Cooper & Smith (1992):* Company specific decision, with integration allowing for synergies while separation providing flexibility ▪ *Gilbert & Bower (2002):* Adopt a modular approach by separating the two businesses at the initial stages and by integrating them over time through an integrator ▪ *Markides* (2008): Company specific decision depending on the degree of conflicts and the degree of synergies between the two businesses	▪ *Serrato et al. (2007):* Definition of a threshold above which to adopt an outsourcing strategy otherwise internalize the reverse supply chain activities ▪ *Fleischmann et al. (2001):* Integrate for sharing fixed assets and reduce costs, but separate for an ease management of the two businesses

3. Methodology and research design

This chapter aims to exhibit readers how the research process has been handled. First, a description of the methodology adopted is presented. Next, the sample of the study is delineated in terms of the setting, the time and the people constituting the research study. Afterwards, an explication of the methods used for collecting and analyzing the data is provided. Finally, considerations related to the quality and the ethics of the study are highlighted.

3.1. Methodology description and justification

In order to present the methodology and the methods adopted for conducting the research study, the "research onion" framework (Saunders, Thornhill, & Lewis, 2009) has been utilized (Appendix 3). This defines the research methodology as being constituted of a sequence of layers which have to be consistent in order to assure a meaningful research. The layers are the following: philosophies, approaches, strategies, choices, time horizons, and techniques and procedures.

Starting from the philosophical paradigm adopted, which is influenced by how we view the relationship between knowledge and the process by which it is developed, the study takes an *interpretivist philosophy* as paradigm for knowledge development. The results of the study are in fact context bounded and company dependent, and the research has not to be seen as an attempt to seek universal patterns or laws that explain certain behaviors with the goal to predict them, as for the positivist philosophy.

As a consequence of the philosophical paradigm undertaken, an *inductive approach* has been chosen as research method, for assuring a formulation of the theory based on the results of the analysis without being tied to a rigid framework which does not permit alternative explanations of what is happening in the real world, as for the deductive approach. Furthermore, the case of two companies is used as an attempt to go from the particular to the general, by understanding how different contexts might change the decisions associated to a specific issue. The purpose of the study is in fact *exploratory*, which consists in finding out what is happening, to seek new insights, to ask questions and to see phenomena in a new light (Robson, 2002).

The strategy adopted for conducting the research is therefore a *dual case study*, where the strategies adopted by Dell and HP for managing their reverse supply chains simultaneously with their forward ones are analyzed. The dual case study allows identifying distinctive features by exploring similarities and contrasts between the two cases and in addition it enables generalizing them to a wider context (Daymon & Holloway, 2011). Further, the case research is a suitable method when a description of events or outcomes allows other researchers to understand the processes and the environment

(McCutcheon & Meredith, 1993). As the aim of this study is to provide evidence that PCs companies can maximize their supply chain KPIs by properly managing the forward and reverse supply chains, this method was deemed appropriate.

3.2. Sample

In order to facilitate the reading of the sample section, firstly the reasons for choosing the specific case will be depicted, and then the sample will be described based on its three main dimensions, as suggested by Hammersley & Atkinson (2007): setting, time and people.

3.2.1. Reasons for choosing the specific dual case

The companies selected for the study have been HP and Dell. HP has been chosen since it leads the PCs market in terms of both volumes and sales value, while Dell, besides being the third leader in the industry, competes with a unique business model constituted by direct selling. This, results in two different approaches adopted by the two companies for the management of their supply chains, and it is therefore interesting to analyze how the two competitors manage their reverse supply chains.

3.2.2. Setting

The study analyses the supply chains of the two companies on a global scale. Although this might lightly defocus the attention on particular aspects of the two supply chains, it has been necessary due to the fact that the data utilized for comparing the KPIs of the two companies have been mostly collected through the annual reports of the two companies. This, results in a comparison of the two organizations on a global scale so it would have been misleading to take a regional or local perspective for the description of the two supply chains. However, even though I have tried to take a holistic view when depicting the supply chains of the two companies, all the primary information have been gathered by interviewing players involved with the Italian market, due to the proximity of the interviewees to the researcher.

3.2.3. Time

The research has been conducted in the period comprised from June 2012 to December 2012, and it consists in a cross sectional study since the research aims to be a snapshot of the current supply chain configuration and strategies adopted by Dell and HP.

3.2.4. People

In order to describe the configuration and the strategies adopted by the two companies I have utilized an heterogeneous sampling strategy by contacting four different people working for different players

belonging to the reverse supply chains of HP and Dell. This allowed me to better understand the challenges of each of them for managing the return processes. The following are the contacts interviewed:

a) Maurizio De Beni – Ecology Alderman – Affi (Verona-Italy)

The interview with Maurizio De Beni, Ecology Alderman of the town of Affi, allowed me to understand the challenges affecting companies and municipalities at the initial stages of the returns of domestic products. This, however, was not sufficient in explaining the role of Dell and HP in the reverse flow.
I managed to contact Maurizio De Beni through the "Centro di Coordinamento RAEE" website, which is the Italian public entity supervising the management of WEEE. The interview was conducted in the office of Maurizio De Beni at the town hall of Affi (Verona) and it has lasted 48.54 minutes. Although the interview has been conducted in Italian, a full transcription in English is available in Appendix 7.

b) Martina Scoponi - Technical Support Engineer - STENA Technoworld (Angiari-Verona-Italy)

The contact with STENA, in the person of Martina Scoponi, has been possible thanks to Maurizio De Beni, who collaborates with the company for handling certain types of WEEE produced in his town. The meeting with STENA let me clarify the processes involved within a recycle facility, from the acceptance of the waste until the recycling of components into raw materials. Moreover, the discussion has been important for depicting the patterns followed by EOL computers assigned to recycle for the reverse supply chain of both Dell and HP. The interview has been conducted at the STENA facility in Angiari (Verona-Italy) and it has lasted around 40 minutes. However, since it has not been possible to record part of the interview due to the visit in the factory, where the noise was excessively loud, only 20.10 minutes of transcription are available in Appendix 8.

c) European Recycling Platform Italy and HP Italy – (Cernusco Sul Naviglio-Milan-Italy)

The interview with a manager of ERP and a manager of HP involved with the return of EOL products for HP has been conducted simultaneously at the HP Italian Headquarter in Cernusco Sul Naviglio (Milan-Italy). The two persons however have preferred not to reveal their names due to the sensitivity of the information provided. Besides this, by interviewing them together, I had the opportunity to better understand the relationship between ERP and HP and the level of integration between the two. Moreover, I could test and correct the information previously collected in relation to the reverse supply chain of HP for finally correctly depicting it. The interview has lasted 52.14 minutes and a full English transcription is available in Appendix 9.

3.3. Data collection process

For collecting the data for the purpose of the study, a *mixed-method research* has been employed, meaning that both quantitative and qualitative data collection techniques and analysis procedures have been sequentially utilized (Saunders et al., 2009). This assures complementarity between the research strategies so that different aspects of the investigation can be dovetailed. Moreover, the combination between qualitative and quantitative research study, let me study different aspects of the situation, with qualitative data helping explaining the relationships between quantitative variables.

In the first instance I have gathered qualitative data for reconstructing the forward and reverse supply chain configurations and the strategies associated to them for both Dell and HP. Data have firstly been collected through secondary data, like articles and websites of the two companies. Regarding the articles, three main sources have helped me in partially reconstructing the supply chains of HP and Dell and in depicting some of the strategies utilized by the two companies. These articles are: "Dell, Inc.'s closed loop supply chain for computer assembly plants" of Kumar & Craig (2007) for the Dell case, "Hewlett-Packard Company Unlocks the Value Potential from Time-Sensitive Returns" of Guide, Muyldermans, & Van Wassenhove (2005) relating to the HP case and "An Exploratory Analysis of Competing Supply Chains in the Personal Computer Industry" of Kumar (2005) for a comparison of the chains of Dell and HP. Secondly, primary data have been collected by conducting four semi-structured interviews with players involved with the reverse supply chain of HP and Dell. Although an interview guide was utilized for conducting each interview, I allowed interviewees to divert from the structured guide and to focus on different aspects that I deemed noteworthy for the research purpose.

In the second instance I have collected quantitative data from the annual reports of the two companies in order to determine their performance in managing their supply chains. Since the two companies adopt different periods of time for determining their fiscal years, I have decided to compare the fiscal year ended the 3rd of February 2012 for Dell with the one ended the 31st of October 2011 for HP, and the fiscal year ended the 28th of January 2011 for Dell with the fiscal year ended the 31st of October 2010 for HP. In my opinion, this choice is the most accurate way for comparing the results of the two companies for the year 2011 and 2010 respectively, although the results of Dell are three months ahead of those of HP. Moreover, as shown in Appendix 5 and 6, I have reclassified the income sheet of both Dell and HP, in order to determine the net operating profit after tax (NOPAT) of the two firms. Data related to the recovery rate, repair turnaround time and lead time have been gathered from the website of the two companies.

3.4. Data analysis

Once collected the data, they have been analyzed in order to derive results for the purpose of the research.

Firstly, I have analyzed the qualitative data. All the interviews have been first recorded, then transcribed in Italian and finally translated in English. Afterwards, I have highlighted the main concepts and then categorized the data based on their relationship with each category. Generally, the categories defined the different players of the reverse flow of EOL computers, and this allowed me to better reconstruct the configuration of the supply chains of Dell and HP by combining the information gathered for each category from the different interviewees.

Secondly, I have analyzed the quantitative data collected through the annual reports of the two companies. I have firstly reclassified the income sheet of both Dell and HP for depicting the NOPAT, and then calculated financial ratios affecting the selected KPIs. It is important to notice that, since balance sheet data represent a snapshot reflecting only a moment; these data have been calculated by averaging the value of the current year with the one of the previous year in order to calculate KPIs based on balance sheet values.
In order to define the best KPIs for comparing the performance of the supply chains for HP and Dell, the Du Pont model has been used (Appendix 4). By decomposing the **Return on Assets (ROA)**, it is possible to see the impact of supply chain decisions on how effectively the two companies manage their assets. For this purpose, I have identified several indicators, for both the forward supply chain and the reverse supply chain, affecting the ROA of the two companies.

Regarding the forward supply chain, the components of the ***profit margin*** have been firstly evaluated for Dell and HP. As a matter of fact, the two companies have been compared based on their *lead time*, which, by affecting the satisfaction of customers, has an impact on the revenues of the company, on the *gross profit margin*, which reveals the efficiency of the procurement and the production process, and on *the sales, general and administrative (SG&A) ratio*, which can give some idea of whether management is spending efficiently the cash flow.
Moreover, in order to understand the asset efficiency of the two companies, the ***asset turnover*** has been decomposed into the following sub-asset categories: *inventory efficiency*, *receivable efficiency*, *plant, property and equipment (PP&E) productivity*. The first two measures together with the *account payable days* help also to evaluate the working capital performance through the *cash conversion cycle index*, which shows how quickly a company can convert its products into cash through sales.

Regarding the reverse supply chain, the two companies have been evaluated only on two measures affecting the ***profit margin***, since, due to the low consideration that companies have on the reverse

supply chain and being the forward supply chain the main business of companies, it is difficult to find data on the performance of the reverse supply chain activities. Dell and HP have therefore been firstly compared based on their *repair turnaround time*, which being the time required for completing the repair/component replacement process, it affects the revenues of the company through the satisfaction of customers. Secondly, the reverse supply chain performance of the two companies has been evaluated based on their *recovery rate*, which identifies the number of units scrapped over the total number of products put into the reverse stream in a period of time (PricewaterhouseCoopers, 2008). This measure affects the revenues, since a high rate is perceived as low involvement in re-sale, repair and refurbishment of the original product, and actively managing recovery options allows companies to achieve highest stakeholder value, and maximize value from sustainability initiatives and take-back innovations.

Finally, the **ROA** of the two companies has been compared and the performance has been explained based on the supply chain decisions made by the two companies.

3.5. Quality of the Research

In order to assure the quality of the research study and demonstrate that the results can be trusted, I have tested my research based on the criteria of validity and reliability, as suggested by Daymon & Holloway (2011).

3.5.1. Validity

The concept of validity consists of three aspects: internal validity, external validity and the terms of relevance, plausibility and credibility (Daymon & Holloway, 2011).

3.5.1.1. Internal validity

This consists in the extent to which the findings and the research accurately reflect the social world of those participating in the study and the phenomenon which has been investigated (Daymon & Holloway, 2011). Internal validity of the research has been assured by the use of the triangulation technique, which has been possible by double checking the answers of each interviewee with the other interviewees and check confirmation on secondary data. Since the main goal of the interviews was in fact to gather information for depicting the configuration of Dell's and HP's forward and reverse supply chains, the opportunity to get in contact with players involved with the different stages of the two chains has allowed me to double check the information provided by each player.

3.5.1.2. External validity

The external validity has been difficult to be assured since the research is case specific and therefore the results are highly company dependent. However, since the flows of EOL computers meant for recycling are managed by collective systems and therefore the processes involved with them are common to all the players in the electronic industry, the configuration of the flows for recycling and disposal can be generalized to the majority of the companies involved with the recycling of EEE.

3.5.1.3. Relevance, plausibility and credibility

The research can be considered relevant to every company involved with the recycling of e-waste, since it shows how two of the leaders of the PCs industry deal with the issue. In addition, I believe that the recommendations provided to the two companies can help them and other PCs companies in improving the way they manage the e-waste process.
The results derived by the findings can also be considered as plausible and credible, since I have shown evidence, through the Du Pont model, of how supply chains decisions affect the overall supply chain performance of the companies. Despite this, more data would have been necessary for better evaluating the performance of the reverse supply chains of the two firms; however few companies are interested in this since the majority does not consider the reverse supply chain as a valuable business.

3.5.2. Reliability

The reliability and replicability of the research have been difficult to attain since the study is context specific. Moreover, being reverse logistics activities in continuous development within companies, evidence found through this study can quickly change because of new supply chain decisions of organizations and of new regulatory requirements. However, I tried to be the less subjective as possible, by gathering the same information through different sources. Moreover, the analytical results analyzed through the Du Pont model can be considered as reliable and replicable since they have been derived from data gathered from the annual reports of the two companies.

3.6. Ethics

In order to guarantee confidentiality and anonymity to the participants at the interviews, at the beginning of each meeting I asked the consent for recording the interview, transcribing the discussion and for reporting the names of the interviewees in the research project. The two managers representing ERP and HP have preferred not to reveal their names in the thesis, moreover the transcription of the interview has been reviewed by them due to the sensitivity of the information provided. On the other hand, all the other interviewees consented to reveal their names.

4. Discussion

The discussion section contains a description of the forward and reverse supply chains of Dell and HP. Firstly the current global computer industry scenario is depicted in order to set the context of the discussion. Afterwards, the two business models of forward and reverse supply chain for both Dell and Hewlett-Packard are presented based on information gathered through business articles, websites of the two companies and interviews with players involved with the two chains. The supply chains of both Dell and HP are described both in terms of their configuration and also in terms of the strategies implemented by the two companies for handling the different players constituting the supply chains.

4.1. The global PCs industry

The personal computers (PCs) market consists of the sale of both desktop and mobile PCs. Desktop PC is a personal computer in a form intended for regular use at a single location, while mobile PCs represent portable personal computers including laptops, notebooks, netbooks and tablet PCs.
The global market consumption volumes reached a total of 295.8 million units in 2011, consisting in total revenue of $160,730.7 million. However, while the market's volume is expected to rise to 431.0 million units by the end of 2016, representing a CAGR of 7.8% for the 2011-2016 period, the performance of the market is forecasted to decline to a market value of $144,643.4 million by the end of 2016, consisting in a CARC of -2.1% for the five-year period 2011-2016, due to intense price competition (MarketLine, 2012).
Mobile PCs sales had the highest volume in the global PCs market in 2011, with total sales of 180.3 million units, equivalent to 61% of the market's overall volume. In comparison, sales of desktop PCs had a volume of 115.4 million units in 2011, equating to 39% of the market total (MarketLine, 2012).
The 40.3% of the global PCs market value is concentrated in the Americas, followed by Europe with 28.8% and Asia-Pacific with 28.4%, while Middle-East and Africa detain only 2.6% of the market value (MarketLine, 2012).
The major PC manufacturers are all relatively large companies but some are very large international corporations. This, results in some players which are strongly focused on the PC market (e.g. Lenovo, Acer), while others have broadly diversified businesses (e.g. Sony, Toshiba). As a consequence, small players have difficulties altering themselves on brand alone and so they compete via price and features instead, which forces price down and features up in some western markets.
As stated by MarketLine (MarketLine, 2012), the global PCs industry is dominated by four companies detaining the 53.6% of the market's volume: Hewlett-Packard (HP) (16.2%), Lenovo (14.0%), Dell (12.8%) and Acer Group (10.6%).

In this paper, I have chosen to compare the strategies adopted by HP and Dell for handling the dual business model of forward and reverse logistics, since HP is the current global market leader of PCs, while Dell competes in the industry with a unique business model through its supply chain which lets the company differentiate itself from the competitors and gain a sustainable competitive advantage.

4.2. Dell Inc.

Dell is one of the leading technology companies, offering a broad range of products, including desktop PCs, servers, networking products, storage, mobility products, software and peripherals, and services. Dell is headquartered in Round Rock, Texas, and employs about 109,400 people (Dell Inc., 2012a). The company is organized along three geographic lines: Americas, Asia-Pacific and Japan, and Europe/Middle-East/Africa (EMEA). Each of the region has its own regional headquarter and its own assembly plants and supply network. Regional headquarters include Bracknell (UK) for EMEA, Singapore for Asia-Pacific and Kawasaki for Japan. In terms of sales, the Americas account for 72% of Dell's revenues, EMEA for 20% of sales and Asia-Pacific equals 8% of sales (Kraemer & Dedrick, 2002). Dell operations are organized around four business segments:

- *Enterprise solutions:* servers, networking and storage products
- *Enterprise services:* infrastructure technology, consulting and applications, and product-related support services
- *Software and peripherals:* printers, PCs accessories, networking and wireless products, digital cameras, and other products
- *Client products:* mobility and desktop PC products.

As demonstrated in figure 4.2-1, client products represent the core business of the company with $ 33,248 million revenues in FY2011, consisting in the 53.6% of total company's revenues (Dell Inc., 2012a).

Figure 4.2-1: Revenue by products and services categories

	February 3, 2012			January 28, 2011		
	(In millions, except percentages)					
	Dollars	% of Revenue	% of Change	Dollars	% of Revenue	% of Change
Client products	$33,248	53.6%	(1.2%)	$33,656	54.7%	13.9%
Ent. Solutions	$10,279	16.6%	3.8%	$9,904	16.1%	20.4%
Ent. Services	$8,322	13.4%	8.5%	$7,673	12.5%	36.5%
Software & Peripherals	$10,222	16.5%	(0.4%)	$10,261	16.7%	8.0%
Dell Consolidated	$62,071		0.9%	$61,494		16.2%

Source: Adapted from Dell Inc. (2012a)

As highlighted by the picture below, within the client products segment, mobility PCs are the most remunerative products representing the 57.5% of total segment revenues and the 31% of total Dell's revenues (Dell Inc., 2012a).

Figure 4.2-2: Dell's client products segment, net revenue

	February 3, 2012			January 28, 2011		
	(In millions, except percentages)					
	Dollars	% of Segment Revenue	% of Change	Dollars	% of Segment Revenue	% of Change
Mobility	$19,104	57,5%	0.7%	$18,971	56.4%	14.2%
Desktop PCs	$14,144	42,5%	(3.7%)	$14,685	43.6%	13.4%
Client products	$33,248		(1.2%)	$33,656		13.9%

Source: Adapted from Dell Inc. (2012a)

4.2.1. Value proposition

Dell Computers has created a unique model within its industry: it pioneered the build-to-order computer business at a time when no one thought that the average customer would have been willing to wait for the arrival of a computer that he or she had not even seen. Now people are logging onto the company website, designing their own computers, and anxiously awaiting arrival. They can track the pace of their ordered computer through the manufacturing process and distribution channel, to the point where customers know what stage of the manufacturing process their customized computer is in at any point on a given day (Kumar & Craig, 2007). This level of transparency allowed Dell to sell one out of three computers in the US (Dell, 2006).

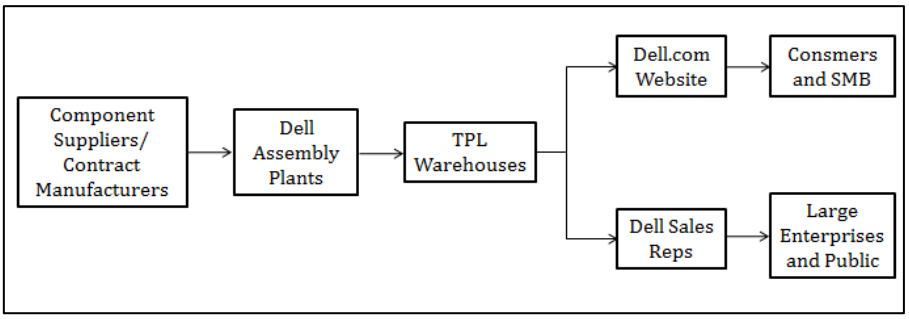
4.2.2. Forward supply chain

When it comes to supply chain management in the computer industry, Dell Computer sets the standard. The company converted its operations to a build-to-order process, eliminated its inventories through a just-in-time system, and sold its products directly to consumers (Kumar, 2005).

4.2.2.1. General structure

Dell is adopting a networking approach for dealing with its supply chain. Dell in fact does not own a manufacturing plant for computer components, but it only handles the key final assembly and configuration processes, with a network of suppliers and contract manufacturers supporting each assembly plant. This is possible thanks to the high commitment of all the players that are involved in Dell's value chain, which as shown below comprehend: component suppliers and contract manufacturers, Dell assembly plants, third-party logistics providers and final customers.

Figure 4.2-3: Dell forward supply chain configuration



Source: Adapted from Dell (2012a)

4.2.2.2. Supply chain strategy

Michael Dell, founder and CEO of Dell, calls the supply chain strategy of the company as virtual integration, meaning that the effective use of technology enables coordination across company boundaries to achieve new levels of efficiency and productivity, as well as extraordinary returns to investors (Magretta, 1998). As a consequence, the virtual integration offers the advantages of a tightly coordinated supply chain that have traditionally come through vertical integration. At the same time, it benefits from the focus and specialization that drive virtual corporations. Thus, Michael Dell envisions virtual integration as having the potential to achieve both coordination and focus (Magretta, 1998). The strategies adopted by Dell for achieving the virtual integration with the different partners in the supply chain are presented below.

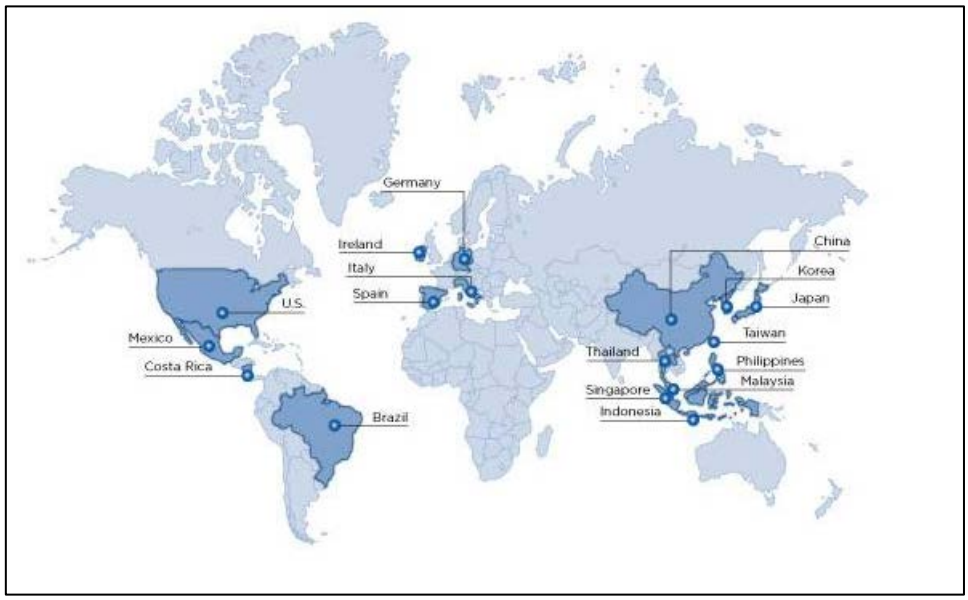
a) Component suppliers and contract manufacturers

- *Configuration*

In order to effectively achieve the virtual integration strategy goal of Michael Dell, the company focuses on cultivating tight supplier relationships so that suppliers can focus on parts innovation while Dell can focus on customers and on the management of the supply chain (Kapuscinski, 2004). The rule followed by Dell is to have as few partners as possible but that will last as long as they maintain their leadership in technology and quality (Magretta, 1998). For assuring this, Dell keeps what it calls a supplier report card on every supplier, and tracks each supplier's performance against a set of metrics maintained by Dell (Jacobs, 2003). As stated by Dick Hunter, vice president of Dell Americas Manufacturing and Distribution Operations, suppliers are primarily evaluated based on four criteria: quality, cost, delivery and technology (Hunter, 2005). As a result of the closed relationship with its suppliers, about 30 of them provide 75% of Dell's direct material purchase spent (Jacobs, 2003). However, in order to avoid shortage of components, Dell has two or more supply sources for each component, except for processors that are entirely bought from Intel Corp (Jacobs, 2003).

Dell's supply chain is extended worldwide and, as depicted by the picture below, they key suppliers are mainly located in Asia, United States and Central America, Brazil and Europe.

Figure 4.2-4: Headquarter locations of key Dell suppliers



Source: Dell Inc. (2011a)

The majority of sourcing is from low cost suppliers in Asia; however some sourcing is from local producers. Regarding the sourcing for the EMEA region, the breakdown of supplies by region is 65 % from Asia, 25% from Europe and 10% from US (Kraemer & Dedrick, 2002). As highlighted by Kraemer & Dedrick (2002), some components are purchased from Asian suppliers; however others are supplied by local manufacturers. For major components, Dell looks for suppliers with global capabilities such as Intel, SCI, IBM, Samsung, Toshiba, Sony and Seagate, while local suppliers in each region provide other parts (Kraemer & Dedrick, 2002). As an example, monitors for the EMEA region are purchased from Sony, Samsung and Acer, and shipped by sea from Asia, but some monitors are also purchased locally from Phillips and Nokia. Regarding contract manufacturers, Foxconn represents an important player for the Asian market (Collins & Grimes, 2011).

- *Coordination*

In order to succeed in the implementation of its forward supply chain, Dell adopts two main supply chain strategies for managing its relationship with its suppliers: modularity and vendor managed inventory.

- *Modularity*

Dell uses the technique of modularity for achieving a high degree of specialization for each component. Modularity involves the organization of complex products by decomposing them into smaller portions

that can be managed independently (Skyott-Larsen et al., 2007). The standardized parts associated with modularization also allow for the components to be built by different suppliers. This let Dell have its supplier to focus on R&D while Dell can focus on quickly utilizing the new technology due to the lack of inventory within its supply chain (Kumar & Craig, 2007). Dell can therefore avoid investment into potentially unprofitable areas and capitalize on new technology developed by its suppliers and put into modular components that are easily integrated into a standard Dell box (Dell, 2006). Moreover, the modularity technique has allowed the firm to effectively implement the build-to-order strategy and to gain a competitive advantage through the mass customization of the final products.

- *Vendor managed inventory*

In order to increase the flexibility of the supply chain, Dell does not manage the inventory but has its suppliers ship components from their factories to revolvers, which are small warehouses located near Dell assembly plants where the suppliers share the rent. Dell indirectly pays for this through the component pricing, but the company does not actually take possession of the inventory until the parts enter the Dell plant. In addition, the company helps its suppliers negotiate transportation costs and it arranges for dedicated shipping space which its supplier can use. Dell also determines the target inventory levels and records supplier deviations to determine incentives. The system ensures that Dell has an aggregate historical service level of 98.8% from revolvers (Kumar & Craig, 2007).
In order to reduce the inventory levels, Dell shares information regarding forecasts with its suppliers to ensure that the assembly plant receives the needed supplies in a timely manner. As a matter of fact, more than 90 percent of Dell's component purchases are now handled online: suppliers use an Internet portal to view Dell's requirements and changes to forecasts based on marketplace activity, and to confirm their ability to meet Dell's delivery requirements. Then, as Dell factories receive orders and schedule assemblies, a "pull" signal to the supplier triggers the shipment of the materials required to build current orders. Dell also provides its customers with accurate delivery dates (Kumar, 2005). As a result of the vendor managed inventory of Dell, the company has three–four days of finished inventory within its supply chain while most of its competitors have between 30–45 days (Hoffman W. , 2005). This lean production to market allows Dell to gain a slight first mover advantage among competitors as a result of its supply chain design.

b) Dell assembly plants

- *Configuration*

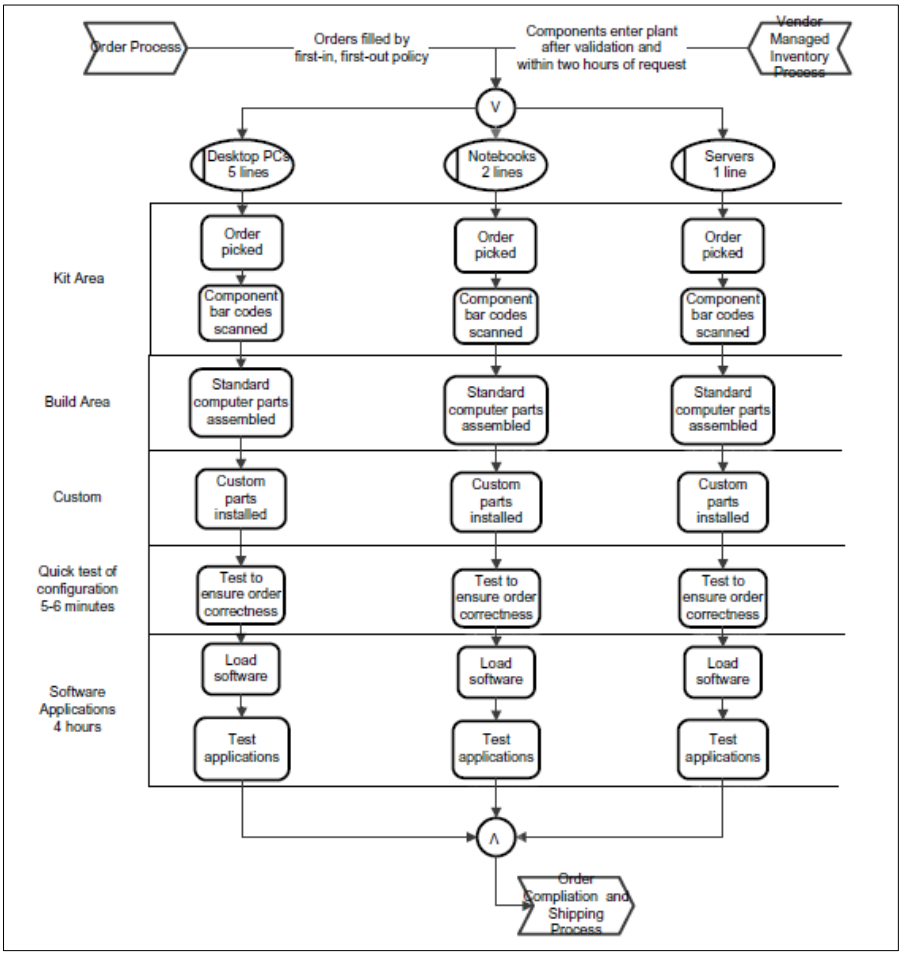
Dell does not manufacture its own components or subassemblies but it handles the final assembly for nearly all of its PCs and servers. The company organizes manufacturing by region, operating a total of six assembly plants to serve its major markets (Dell Inc., 2011b):

- Americas:
    - Texas – Austin
    - Brazil – Hortolandia
- EMEA
    - Poland – Lodz
- APJ
    - China – Xiamen
    - Malaysia – Penang
    - India - Chennai

In order to decide where to open each plant, Dell bases its decision on five key factors: market access, labor cost and quality, transportation and telecommunications infrastructure, government incentives, and absence of industry clusters (Kraemer & Dedrick, 2002).

The figure below shows the processes involved within a typical Dell assembly plant.

Figure 4.2-5: Computer assembly process for a Dell assembly plant



Source: Kumar & Craig (2007)

The assembly process consists of assembly, software installation, functional testing, and quality control (Dell Inc., 2011b). Once all the components arrive at the plant, the order enters a queue that is based on the first-in, first-out order fulfillment system. This could cause issues with scheduling, but Dell has implemented flexible production lines within the plant. Each production line goes through the same process: the components are collected and scanned within the kitting area. From there, the components move to the build area where the general configuration is assembled. After this, the PC is moved to the custom area for the installation of customized components. Then a five to six minute test is done on the repeated configuration to ensure that it is working properly before the computer is sent to the software application area, where the software is loaded onto the computer and the applications are tested. The entire process takes eight hours (Kumar & Craig, 2007).

- *Coordination*

For rendering effective its build-to-order strategy, Dell utilizes the postponement technique in its assembly plants, which is possible thanks to the modularity of components.

  - *Postponement*

Postponement is the practice of delaying the final configuration of the product for as long as possible. This, combined with the modularity of components, allows for last minute changes in the assembly of a product or it can allow for a shorter lead time. Dell in fact keeps its computer configuration uncommitted for as long as possible to enable customization of products while maintaining economies of scale. As a result, postponement allows Dell to make an estimated 100 million computer configurations (Hoffman M. , 2005).

c) TPL warehouses

- *Configuration*

Dell works closely with TPL providers, such as UPS, DHL, FedEx and DB Schenker, for distributing the product from Dell's assembly plants to the final customers.

In EMEA, Dell has five distribution hubs to take advantage of location close to major markets, transportation networks and logistics expertise. The distribution hubs in EMEA are:

- Lodz - Poland: for Eastern Europe, Middle East and Africa (except South Africa)
- Liverpool – United Kingdom: for UK
- Tillberg - Netherlands: for Middle Europe
- Gottenberg - Sweden: for Nordic countries
- Johannesburg – South Africa: for South Africa

A different logistics partner operates each hub. Similar outbound staging areas and arrangements with logistics partners exist in the Americas and Asia-Pacific (Kraemer & Dedrick, 2002).

- *Coordination*

In order to reduce the lead time of the products, Dell adopts the postponement strategy also with its distributors. Moreover, Dell has partnered with FedEx for handling the majority of its shipping.

  - *Postponement*

The last stage of the assembly process is handled by TPL providers in different distribution hubs. The TPL provider in fact combines the portions of the order it received from Dell's assembly plant with the monitor that it picked up from the manufacturer and any other last minute add-ons. The computer is then shipped directly to the customer who receives an e-mail with an expected time of delivery (Kumar & Craig, 2007). As a result of the effectiveness of the Dell's supply chain, the company ships products to 180 countries worldwide, at a rate of one system per second (Dell Inc., 2011c).

  - *Partnership with FedEx*

As previously stated, Dell has partnered with several logistics partners (UPS, DHL, FedEx, DB Schenker) to ship products safely to customers. However, since FedEx has been able to successfully coordinate Dell's business transactions over the years, it has a close relation with Dell and it takes care of the majority of Dell's shipping (Aghazadeh, 2007).

d) Final customer

In order to sell its products, Dell has segmented the market into the following four clusters, which have been defined by how clients use technology rather than where they use it (Dell Inc., 2011b):

- Large Enterprises – large global and national corporate businesses
- Public – educational institutions, government, health care, and law enforcement agencies
- Small and Medium Businesses ("SMB")
- Consumers

This segmentation allows the company to have a good mix of demand, in fact there is no customer representing one to two per cent of Dell's revenues (Magretta, 1998). However, as shown in figure 4.2-6, the large enterprise, public and SMB segments, which are defined as "commercial segment", represent approximately 80% of Dell's total net revenues (Dell Inc., 2012a).

Figure 4.2-6: Dell's net revenue and operating income by segment

	February 3, 2012 (In millions, except percentages)	
	Dollars	**% of Revenue**
Large Enterprise	$18,457	29.7%
Public	$16,548	26.7%
SMB	$15,166	24.4%
Consumer	$11,900	19.2%
Total Revenue	$62,071	

Source: Adapted from Dell Inc. (2012a)

Dell adopts different sales channels for dealing with the first two clusters compared to SMBs and domestic consumers. While in fact sales representatives deal with the large corporate and institutional accounts, online orders are used by individual consumers and SMBs (Kumar & Craig, 2007). The two channels are then combined in the ordering system, which performs a credit check and hold on individual customers. The sales representatives and the e-commerce channel will be discussed in separated sections.

i) Sales representatives

- *Configuration*

Dell adopts dedicated account teams for dealing with large businesses and institutional customers. In 2012, the company has unified its global sales and marketing teams in an effort to create a more responsive and efficient sales organization. Dell believes that this change will create a sales organization that is more customer-focused, collaborative, and innovative. The adoption of dedicates sales teams, which include field-based enterprise solution specialists, allows Dell to form long-term relationships with corporate customers in order to provide them with a single source of assistance, develop tailored solutions for them, and provide Dell with customer feedback (Dell Inc., 2012a).

- *Coordination*

In order to maintain close relationships with its large and institutional customers, Dell has integrated the ordering system with the ERP system of major customers, moreover, in order to maintain stable inventory levels, Dell sales reps manage to shape the demand of products depending on inventory constraints of components.

  - *Integrated Dell computer ordering system with major customers' ERP systems*

Dell has integrated its computer ordering system with the enterprise resource planning system of some major customers, like Medtronic, Inc. (Joachim, 1998). This allows IT departments to have

control over the configurations ordered from Dell while Dell can continue to maintain its relationship with the corporate client. Moreover, this strategy let Dell know approximately the amount of new computers needed by the corporate customer each year, smoothing out the demand fluctuations for their computers. In addition, customers will have assurances that all computers within the network will have the same basic software and hardware, resulting in higher compatibility between computers and lower maintenance costs for the customers (Kumar & Craig, 2007).

- *Demand shaping*

Dell adopts a technique called "demand shaping" for dealing with final customers' orders. Each day, Dell sales people receive a report that says which parts can go into an extended lead time. This allows them to know what inventory constraints exist within the system so that they know what they should and should not be selling based on these inventory levels (Davis, 2004). For example, when the inventory for a component runs low within the Dell revolvers, Dell runs a promotion on another substitute part of equal or greater quality. If Dell has a component that is not rotating quickly enough through the revolver, it will run a promotion on that product to increase customer demand for it. This helps to shift customer demand from the standard ordering patterns. Because of the large volume of information Dell maintains regarding customer behavior and demand patterns, it is able to make these promotional adjustments and fairly accurately predict the result. The constant monitoring of demand with orders also allows Dell to stop the promotion as soon as the inventory levels have returned to levels that Dell finds comfortable. Dell also works to manage the timing of orders. Because it deals with a first-in, first out scheduling system and must satisfy individual customers and corporate customers, demand could spike outside of a plant's capacity levels. To avoid this, Dell closely monitors its orders that are in the scheduling queue (Kumar, 2005). When this back-up goes above two days, the company encourages its sales force to pull off customer demand (Davis, 2004), since large orders from corporate and institutional clients could cause a demand spike (Dell Inc., 2006b).

ii) Dell.com

- *Configuration*

Dell sells products to individual consumers and SMBs through the online direct channel consisting in the website of the company, www.dell.com. Customers can simply log in into Dell.com website, configure and personalize their computer and order it. Once ordered the product, customers receive an e-mail with an expected time of delivery. Customers can also track the delivery process and see which checkpoints the order has passed through on the way to the computer's final destination.

- *Coordination*

Dell organizes its sales effort around the evolving needs of its customers, and as a consequence of this, the direct business model allows a direct communication with them for refining Dell products and its marketing programs depending on the specific customer group. For this purpose, Dell has developed the IdeaStrom website and social networks initiatives in order to have a direct and transparent contact with its customers.

- *IdeaStorm*

IdeaStorm is a website launched in February 2007 by Dell with the goal to give direct voice to customers allowing them to share ideas and collaborate with one another and Dell. In addition to the open discussions, in December 2009, Dell added "Storm Sessions" where Dell posts a specific topic and asks customers to submit ideas. Moreover, in 2012 Dell created idea "Extensions" where an idea poster can promote a comment made on his/her idea to be considered a part of it. This enables ideas to evolve over time through collaboration. As a result, IdeaStorm has crossed 16,000 ideas and implemented nearly 500 of them from its launch (IdeaStorm, 2012).

- *Social networks*

Dell also uses various social media to listen, learn and engage with customers. Through social media, customers take part in more than 25,000 conversations about Dell every day (Dell Inc., 2012c). The most utilized social networks are Facebook and Twitter. Regarding Facebook, the company has created Dell pages in order to promote Dell product launches, inform customers about news, events and more. Twitter is instead used by Dell in order to quickly share information with people interested in its products and services, gather real-time feedback and build relationships with customers, partners and other influential people. In fact, besides being an information tool, Twitter is also used by the company as a sales and support channel (Dell Inc., 2012c).
The close relationship with final customers has allowed Dell not only to improve the value delivered to its customers, thanks to the fast and direct exchange of information, but also to better forecast the demand. In fact, as stated by Michael Dell, "the more intermediary you add, the less likely it is you will have good information about demand, so you will end up with more variability, more inventory, higher costs, and more risks" (Magretta, 1998).

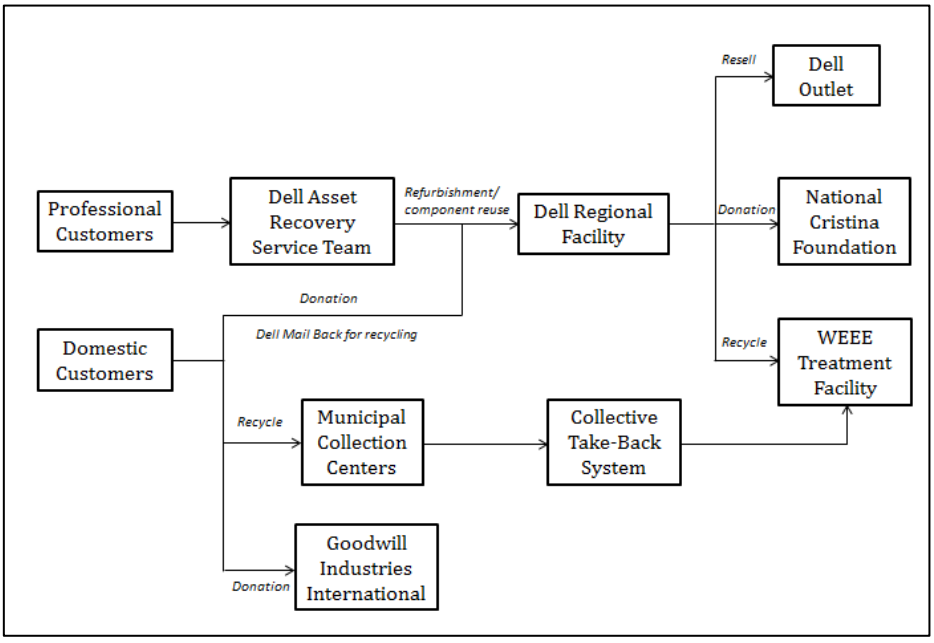
4.2.3. Reverse supply chain

In 2011, Dell recycled more than 150 million pounds of electronics globally with the goal to recycle more than one billion pounds of e-waste by 2014. This has been possible thanks to the extension of free global recycling to 78 countries (Dell Inc., 2011c). As a result of the efforts made by Dell, the company has been awarded with the highest grade in the computer industry for its take-back program by the Electronics Take-back Coalition in 2010 (Electronics Take Back Coalition, 2012a).

4.2.3.1. General structure

The recovery of the EOL products is managed differently by Dell, depending on whether these are professional EOLs or domestic EOLs. Professional EOL computers relate to the EOL equipment of businesses and public customers, while domestic EOL computers identify the equipment of individual consumers. Figure 4.2-7 shows the players and processes involved with Dell reverse supply chain.

Figure 4.2-7: Dell Reverse Supply Chain for EOL computers



Professional customers can decide whether to donate, resale or recycle the old equipment. For each of these cases, a Dell Asset Recovery Service team comes to the work site of the client for recovering the equipment and recommending a best option. If some value can be recovered from the equipment, this is sent to a Dell regional facility where computers are completely refurbished or components are saved for reutilization. Based on the customer decision, computers are then either donated to charity through the National Cristina Foundation (NCF) (this option is only available in US) or resold in a secondary market through the Dell Outlet. The entire process is completely overseen by Dell.

Domestic customers instead, can either donate or recycle the used equipment. In case of donation, customers can drop off the used equipment at any NCF or Goodwill location (only in US), while in case of recycling, customers can either bring their computers to a municipal collection center or ship the equipment to Dell through the Dell Mail Back program. The equipment brought to the collection center is transported from a collective system to a treatment facility for proper recycle or disposal. Except for the Dell Mail Back, the domestic return process is completely outsourced to third party partners.

4.2.3.2. Supply chain strategy

Dell adopts two different strategies for managing the returns for professional customers and for domestic customers. While the reverse flow for professional EOL equipment is internalized and directly managed by Dell, the management of domestic returns is outsourced to external partners. For this reason the two flows will be discussed in separated sections.

4.2.3.2.1. Professional EOL returns

In order to deal with the returns of business customers, Dell has implemented the Asset Recovery Services program which is currently running in 38 countries. The program provides the logistic and disposal capabilities to recover and dispose of owned and/or leased equipment in a secure environmentally safe way (Dell Inc., 2011c). If some value can be extracted from the used equipment, business customers can decide, once products have been refurbished, whether to resell it through the Dell Outlet, or to donate it to the National Cristina Foundation (NCF). In case products cannot be refurbished, components are firstly evaluated for reutilization and components that cannot be reused are sent to a recycle partner for proper disposal. Besides receiving a certificate of proper disposal, business customers can also have the opportunity to recover some value from the EOL equipment in case the product is resold.

a) Dell Asset Recovery Service teams

- *Configuration*

For managing the reverse flow of business PCs Dell has organized special recovery teams through the Dell Asset Recovery Service program. A Dell team comes to the work site of the client and hauls away the computers as part of the contract that Dell has with that client. Dell also overwrites the hard drives to ensure confidentiality of its client's information (Sternstein, 2005). In order to provide a higher level of security to the customer, the data wipe process can be performed on site by a Dell's team.

- *Coordination*

  - *Internalized process*

The business recovery process is directly managed by Dell and customers can contact their personal Dell representative in order to benefit from the program. This assures a transparent return policy which results in a more effective handling process. As a matter of fact, Dell Asset Return Service has resulted in a 96% overall customer satisfaction rating (Dell Inc., 2006a).

b) Dell regional center facilities

- *Configuration*

All the equipment collected by the Asset Recovery Service Teams is returned to a regional Dell facility. Here the equipment received by business and individual customers, from which some economic value can be extracted, is examined to determine its condition. At the Dell's equipment processing site a functional test is performed to check and record the degree of functionality, RAM and hard drive sizes, processor speed, display, monitor and printer performance, etc. Based on this functional test, a grade is awarded to the equipment which determines its future use.
From this point a computer can have four possible destinations. It can be donated to NCF, when requested by the customer, otherwise products that can be resold are moved to the facility where their parts are replaced if needed; they are then registered on Dell's Outlet website, and moved to a logistics hub. If refurbishment is not possible, component reuse is the next option: the usable components and materials are retrieved and are moved into the logistics hub. This spare parts inventory is utilized in case of service calls, where they can be used for replacement of components of computers acquired for resale. Any component that Dell cannot use is sent to a company's recycle partner for proper disposal or for further breakdown into basic materials (Kumar & Craig, 2007).

- *Coordination*

Dell has implemented specific design policies for easing the disassembly process of its EOL products. Since the earliest stages of product development, Dell products, parts and components are designed to be upgraded in order to extend the life of each product. Dell also collaborates with recyclers and asset recovery partners to determine what kind of design features will make product recycling easier. There are three main techniques adopted by Dell to ease the disassembly process (Dell Inc., 2012e):

  - *Modularity*

The majority of components found inside Dell products are easily removable, with standardized parts. This makes it easier to reuse or recycle them.

- *Design for disassembly*

By designing smarter, Dell has cut down on the number of screws in its products, and the ones that remain are easier to access and more consistent in type. All parts are easily separable with commonly found tools.

- *Minimal glues and adhesives*

Glues and adhesives can create processing challenges for recyclers, so Dell has come up with other methods, such as innovative snap fits, to accomplish the same design goals.

c) Dell Outlet

- *Configuration*

Dell resells refurbished products through Dell's Outlet website where customers can save up to 25% of the original price while carrying a same-as-new warranty. These items are resold as three different types of products:

- *Certified Refurbished*
  These are laptops and desktops that have been returned to Dell, put through the production process and then again retested to ensure they meet all original factory specifications. Certified refurbished systems may have some observable cosmetic blemishes, but they do not affect performance.
- *Dell Outlet New*
  They are PCs and enterprise products that were canceled orders, or systems that were shipped out to a customer who decided to return the system without even using it. Dell Outlet New systems do not have any cosmetic damages.
- *Scratch and Dent*
  These are systems with considerable cosmetic blemishes that do not affect performance. They are a great way to save money while still enjoying Dell Outlet's rigorous rebuilding and testing process.

As a result of Dell's recycling program, the company refurbishes and sells over 94 percent of all returned Dell systems (Dell Inc., 2012f).

- *Coordination*

Dell has implemented strategies for augmenting the integration between the refurbished business and the brand new one. The company in fact does not fear the risk of cannibalization between the two businesses, but it views it as an opportunity for attracting different segments of customers. The

strategies adopted by Dell for this purpose consist in e-business solutions, like the Dell Outlet website and the @Dell Outlet account on twitter.

- *Integration with Dell.com*

The Dell Outlet website is easily accessible from the Dell.com website and this allows customers to easily choose whether to buy a new product or a refurbished one from the same website. Dell therefore considers the brand new market and the refurbished one to be compatible and does not fear the risk of cannibalization of the brand new products by the refurbished ones.

- *@DellOutlet on Twitter*

Dell has set up a global team of around 40 employees for managing the relations between the Dell Outlet and customers via Twitter (NevilleHobson.com, 2009). With its 624,000 followers @DellOutlet announces company and product news and talks directly to customers, responding to complaints or asking for feedback. Moreover, Dell uses Twitter for sending out coupons, including some that are exclusive to its Twitter followers. This social media tool is particularly useful for the Dell Outlet, since the inventory of returned and refurbished products fluctuates and thus it is a great way for connecting quickly with customers. As a result, in 2009 Dell reached earnings of $3 million in revenue directly through Twitter since 2007, and while $2 million regarded refurbished and reused product sold through the Dell Outlet, another $1 million were earned from people who clicked from Twitter to Dell Outlet to Dell.com and made a purchase there (Miller, 2009).

d) National Cristina Foundation (NCF)

- *Configuration*

Dell has partnered with National Cristina Foundation (NCF) for letting customers donate their old equipment to economically disadvantaged people. This donation program was launched in 2001 after Dell discovered that people were searching for donation options for their used PCs (Wireless News, 2006). The program is available for both business customers and individual customers; once the computers have been refurbished at Dell facility they are sent to NCF.

- *Coordination*

  - *Increase the number of collection points*

The collaboration with NCF has let Dell increase the amount of collection points for the used equipment both for individual customers and small businesses. Dell clients can in fact drop off their used computers, peripherals and other business technologies at a NCF location, or schedule a pickup. In return, Dell offers a 10 percent discount on the following online software or accessories purchase

(Dell Inc., 2012b). This way, Dell outsources the collection process to a charity organization which results both in a costs' reduction for the collection and in an improvement of Dell's corporate image.

e) WEEE treatment facilities

- *Configuration*

Components that cannot be utilized for the refurbishment process are resold for parts or recyclable materials (Dell Inc., 2012f). These are transported by an authorized logistic provider to a treatment facility which is outsourced to external partners. In order to handle the recycling process, Dell has 65 recycling partners worldwide located (Smith P. , 2011).

Treatment facilities receive waste from both private companies and collective systems, which will be later described; however flows from collective systems represent the majority of arrivals. As an example, for STENA they represent the 80% of the total equipment received (Scoponi, 2012). Usually, WEEE treatment companies deal with all the categories of WEEE; notwithstanding this the purchasing process of the material depends on the type of waste. In fact, treatment companies are paid for receiving hazardous materials but, on the other hand, they pay for receiving non-hazardous material. In practical terms, refrigerators, neon lights and televisions represent a source of revenue for the treatment facilities; while the receipt of washing machines, dishwashers, and electronics, so also the PCs, is a cost (Scoponi, 2012).

Once the waste arrives at the facility, it is firstly weighted and then unloaded on a conveyor. From here the waste reaches the disassembly area, where workers disassemble the products into components. The material is then sorted based on the typology, for example steel, aluminum, copper, plastic, etc. This is then reused for creating new products or dismantled in a safety and ecologically way. This approach, besides being environmental friendly, can reduce the need of raw materials for the production of new products (Scoponi, 2012).

- *Coordination*

  - *Zero waste approach*

Dell believes that zero waste (producing, consuming and recycling without throwing anything away) is an ethical and cost-efficient and visionary approach that all manufacturers should employ. In pursuing this goal, Dell has achieved a recycle and reuse rate of 98 percent in 2012 (Dell Inc., 2012d). This has been possible thanks to highly efficient manufacturing and operational processes for reducing waste and to the strong relationship with all the actors involved with the reverse flow of products.

4.2.3.2.2. Domestic EOL returns

For effectively dealing with domestic returns, Dell has launched a number of programs. A first option for consumers when returning a used item is to contact Dell through the Mail-Back Recycling program for sending the used equipment directly to the producer or to a recycling partner. Secondly, customers can donate their used equipment either to NCF, as for the professional EOLs, or to Goodwill Industries International through the Dell Reconnect program. If none of these options satisfy the customers, they can bring the EOL equipment to a municipal collection center.

a) Dell Mail-Back Recycling Program

- *Configuration*

When recycling a used Dell, customers can benefit from the Mail-Back recycling program which allows customer to ship their used computers to Dell directly from home. In addition, customers can get some value from their used equipment through the TechForward Guaranteed Buyback® Plan. At any time, up to two years after the purchase, customers can send their computer to Dell for free and know exactly how much they will receive for it. The value recovered depends on the age of the equipment; in fact usually the value given back is the following (Dell Inc., 2012b):

- 0-6 months: 50% back
- 6-12 months: 40% back
- 12-18 months: 30% back
- 18-24 months: 20% back

- *Coordination*

For effectively managing the reverse flow of domestic products, Dell has setup a screening gate before collecting the equipment, through a preponement strategy. Moreover, the company has partnered with FedEx for managing the reverse stream of EOL products.

  - *Preponement*

In order to reduce the unwanted returns to the regional facility, a preponement strategy is adopted by Dell (Guide, Souza, Van Wassenhove, & Blackburn, 2006).The strategy consists in screening the potential valuable computers at the time when the mail back service is required. Computers, in fact, cannot be returned unless a phone call has been placed to a technical customer service representative. The agents can often walk consumers through set-up and early usage issues and, in effect, talk them out of returning the machines (UPS, 2005). The strategy allows Dell to decrease extra transportation and handling costs, and puts low-touch returns back on the shelves much faster.

- *Partnership with FedEx*

Dell has partnered with FedEx for rendering the recycling process simpler for customers. FedEx picks up any Dell product for free at the customer location, and brings it back either to the Dell regional facility, for evaluating the condition of the equipment, or directly to a recycling center. Customers are however responsible for deleting all data from the hard drive. The program is for free when recycling a Dell computer, but in addition, Dell does also recycle for free a non-Dell-branded product when buying a new Dell (Dell Inc., 2012b).

b) National Cristina Foundation (NCF)

- *Configuration*

A second option for domestic customers when returning their used computers is to donate them to NCF. This, as previously stated, besides helping poor people, let individual consumers more easily dispose of their used equipment by simply bringing it to a NCF location or by scheduling a pickup. As a result, customers will get a 10% discount on the following online software or accessories purchase. Notwithstanding this, the program is available only in United States and Canada (Dell Inc., 2012b).

c) Dell Reconnect - Goodwill Industries International

- *Configuration*

A third possibility for customers when recycling a Dell is to donate it to Goodwill Industries International through the Dell Reconnect program. In US and Canada, the company has in fact signed an agreement for cooperating with Goodwill for the recovery of EOL computers. This is a network of 165 community-based, independent agencies in United States and Canada with 14 affiliates in other 13 countries. Goodwill agencies are innovative and sustainable social enterprises that fund job training programs, employment services and other-community based programs by selling donated clothing and household items in more than 2,600 stores (Goodwill Industries International, Inc., 2011).
Dell customers can return computers to a Goodwill location, where employees inspect each item and determine whether to reuse, refurbish or recycle it. Once a device has been designated as reusable, it is cleaned and tested so that it can be resold in a Goodwill store. This process not only gives families the possibility to buy a working computer at a great price, but also creates “green jobs” for the community. Whatever part cannot be reused or refurbished, it is broken down securely and recycled responsibly so that its valuable material can be reprocessed to create new products (Dell Reconnect, 2012).

- *Coordination*

    - *Outsourced recycling process*

The partnership with Goodwill has allowed Dell not only to augment the number of collection points available in North America, but also to outsource the refurbishment and recycling process for part of the returns. This has let Dell increment the amount of e-waste recovered, while reducing the costs associated to reverse supply chain activities and improving the corporate image of the company.

d) Municipal collection centers

- *Configuration*

If none of the above mentioned options suites customers, individuals can bring the used equipment to a municipal collection center for proper disposal. These are municipal entities responsible for the collection of domestic WEEE from individuals in their respective village/town. Here WEEEs are collected in large cases based on their specific category. In Italy there are 5 categories for identifying and collecting WEEE (De Beni, 2012):

- R1: Refrigeration equipment
- R2: Stoves and washing equipment
- R3: Televisions and monitors
- R4: PED, CE, ICT and lightning equipment
- R5: Light sources

Once having reached a specific amount of waste, a collective system recovers the waste and brings it to a WEEE treatment facility where the treatment process takes place. The recovery of WEEE from collection centers to the WEEE collection facilities is free of charge for the collection centers and it is completely paid by the collective systems through the producers. Collection centers are however responsible for the WEEE until it reaches the WEEE treatment facility (De Beni, 2012).
Moreover, efficiency awards for collection centers have been implemented by the collective systems. The awards have the goal to improve the quality of the collection of e-waste by the municipalities and they are assigned based on the quality of the collection, on the replenishment process and on the visibility to citizens, which is measured by the number of products returned (HP & ERP, 2012).

e) Collective take-back systems

- *Configuration*

In Europe, the recycling process is managed by collective systems for recycling. These are authorities responsible for the management of the WEEE and they are directly funded by the EEE producers. In addition, collective systems control the quality of the recycling processes and provide auditing services to the players involved in the recycling business.
In Italy, the Centro di Coordinamento RAEE is the entity responsible to regulate the collection of WEEE from the collection points until the treatment facilities. In order to improve the effectiveness of the recovery process, the Centro di Coordinamento RAEE has favored the growth of independent collective systems (14 or 15 in Italy) to which a number of collection centers is assigned, depending on the WEEE category. In order to render equal the collection process for the different systems and assure a fair distribution of responsibilities, the allocation of the collection centers has been assigned considering the distance between the treatment facilities and the collection centers, so that all the collective systems put the same effort for the collection of the waste (HP & ERP, 2012).
Each producer of EEE pays an annual fee to a collective system for the collection of the waste, depending on the amount of waste produced. The European Directive has approved the individual responsibility for producers; however it has been difficult to put it into practice due to the difficulties in tracing the distribution of returns per brands. As a result, the market share in the main business is used as an estimate for the returns. It is in fact supposed that the more the products sold by a company, the more the products returned of that company. However this is not always the case, since companies which invest a lot for improving the life cycle of their products, will have PCs with longer life cycle than companies that do not invest in it. As a result, the amount of products returned will be higher for companies producing products with a low life cycle (HP & ERP, 2012).
When the recycling centers have reached the maximum capacity of WEEE, they contact the treatment facility associated with the collective system, which has 48 hours for collecting the material and bringing it to the treatment facility. The collective system pays the recycling partner the treatment and the logistics service for the dangerous equipment (monitors), while the recycling company has to pay for the rest (electronics) (Scoponi, 2012).

- *Coordination*

  - *Outsourced WEEE collection process*

Dell has outsourced the collection of e-waste to an external partner. In fact, by law EEE producers need to be registered with a determined collective system to which they pay an annual fee dependent on the amount of WEEE generated by the company.

4.3. Hewlett-Packard (HP)

HP is a leading global provider of products, technologies, software, solutions and services to individual consumers, small- and medium-sized businesses (“SMBs”) and large enterprises, including customers in the government, health and education sectors. In the computer segment, HP provides personal computers (desktops and notebooks) for both commercial and consumer use (Reuters, 2012).
The company is headquartered in Palo Alto, California and employs 349,600 people (Datamonitor, 2012) but it is worldwide located and has divided its operations in three geographical areas: Americas, with general headquarter in Palo Alto, California; EMEA, with regional headquarter in Geneva, Switzerland; and Asia Pacific with regional headquarter in Singapore (HP, 2011b). While the Americas and the EMEA region account for the majority of HP revenues (46% and 36% respectively), the Asia Pacific area accounts only for 18% of the total HP revenues (Supply Chain Council, 2010).
HP operations are organized into six business segments: Personal Systems Group (“PSG”), Imaging and Printing Group (“IPG”), Enterprise Servers, Storage and Networking (“ESSN”), Services, HP Software and HP Financial Services (“HPFS”). As demonstrated by the figure below, the core of HP business is the hardware products, which includes PCs (“PSG”), servers, storage and networking (“ESSN”), and imaging and printing products (“IPG”) (HP, 2011b).

Figure 4.3-1: HP revenue by products and services segment

	October 31, 2011			October 31, 2010		
	(In millions, except percentages)					
	Dollars	% of Revenue	% of Change	Dollars	% of Revenue	% of Change
PSG	$39,574	30.4%	(2.9%)	$40,741	31.8%	15.4%
IPG	$25,783	19.8%	0.1%	$25,764	20.1%	7.3%
ESSN	$22,241	17.1%	9.3%	$20,356	15.9%	26.3%
Services	$35,954	27.6%	1.2%	$35,529	27.7%	0.4%
HP Software	$3,217	2.5%	17.9%	$2,729	2.1%	2.8%
HPFS	$3,596	2.8%	18.0%	$3,047	2.4%	14.0%
HP Consolidated	$127,245		1.0%	$126,033		10.0%

Source: Adapted from HP (2011b)

In this paper, I will focus my attention on the Personal System Group segment (“PSG”), which provides commercial PCs, consumer PCs, workstations, calculators, and other related accessories, software and services for the commercial and consumer markets.
As highlighted in figure 4.3-2, the notebooks segment is the most remunerative within the Personal Systems Group.

Figure 4.3-2: HP's Personal Systems Group, net revenue

	October 31, 2011			October 31, 2010		
	(In millions, except percentages)					
	Dollars	% of PSG Revenue	% of Change	Dollars	% of PSG Revenue	% of Change
Notebooks	$21,319	53.9%	(5.7%)	$22,602	59.3%	12.0%
Desktops	$15,260	38.6%	(1.7%)	$15,519	40.7%	20.0%
Workstations	$2,216	5.6%	24.1%	$1,786	4.7%	42.0%
Other	$779	2.0%	(6.6%)	$834	2.2%	(10.0%)
PSG Segment	$39,574		(2.9%)	$40,741		15.4%

Source: Adapted from HP (2011b)

4.3.1. Value proposition

The computer segment where HP operates is intensively competitive and it is characterized by price competition and inventory depreciation. However, HP has been able to gain a competitive advantage thanks to its broad product portfolio, its innovation and R&D capabilities, its brand and procurement leverage, its ability to cross-sell its portfolio of offerings, its extensive service and support offerings and the availability of a broad-based distribution of products from retail and commercial channels to direct sales (HP, 2011b).

The company has therefore gained a strong market position in various market segments thanks to its differentiation strategy, which provides economies of scale for the company, besides increasing its chance of winning customers. However, this has also caused a lack of significant presence in various segments of the IT market when compared to its major competitors (Datamonitor, 2012).

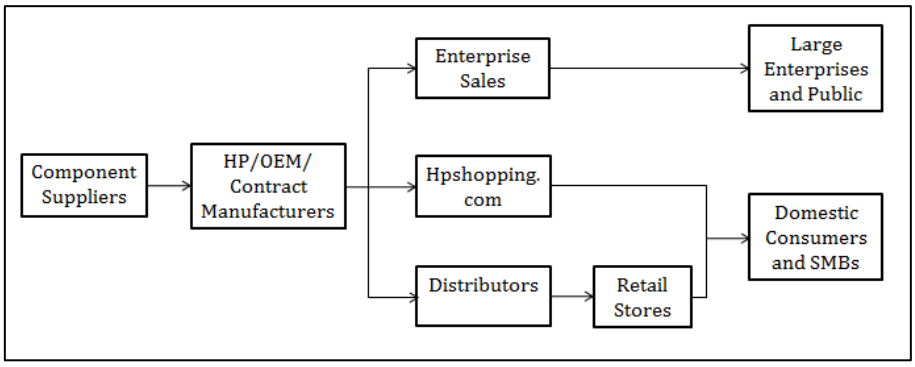
4.3.2. Forward supply chain

Today, HP is the ninth largest industrial supply chain in the world and the largest supply chain in high technology in terms of dollars, breadth, product complexity, and global reach (HP, 2004). In order to maximize the added value to customers, HP is delivering its final products both through a direct channel to final consumers and through an indirect channel to retailers (Kumar, 2005).

4.3.2.1. General structure

HP does not use a fix structure for managing its supply chain, but adopts different configurations depending on the type of supplier, product, customer and geographical market. In fact, HP believes that customer buying patterns and different regional market conditions necessitate sales, marketing and distribution to be tailored accordingly (HP, 2011b). The figure below depicts the typical configuration of the HP supply chain:

Figure 4.3-3: HP Forward Supply Chain Configuration



Source: Adapted from HP (2011b)

4.3.2.2. Supply chain strategy

In order to handle its supply chain, HP adopts a design for supply chain approach, which consists in looking at the costs throughout a product's life cycle, even past the point of its functional use. Design for supply chain requires the involvement of multiple departments when a product is being designed, as stated by Greg Shoemaker, HP's vice president of central direct procurement, "design for supply chain includes not only R&D type people but also people involved with logistics and packaging, and people who are focused on the environment. When we design for logistics enhancements, for instance, we make sure we've got the right size box that will fit on the right size pallet to optimize our shipping costs. When we design for tax and duty reduction, we may manufacture in certain places in the world in order to reduce our taxes or duty" (Shoemaker, 2005).
The design of the products fits therefore the need of the different partners in the supply chain. Below, the strategies adopted by HP for dealing with partners at each stage of the supply chain are presented.

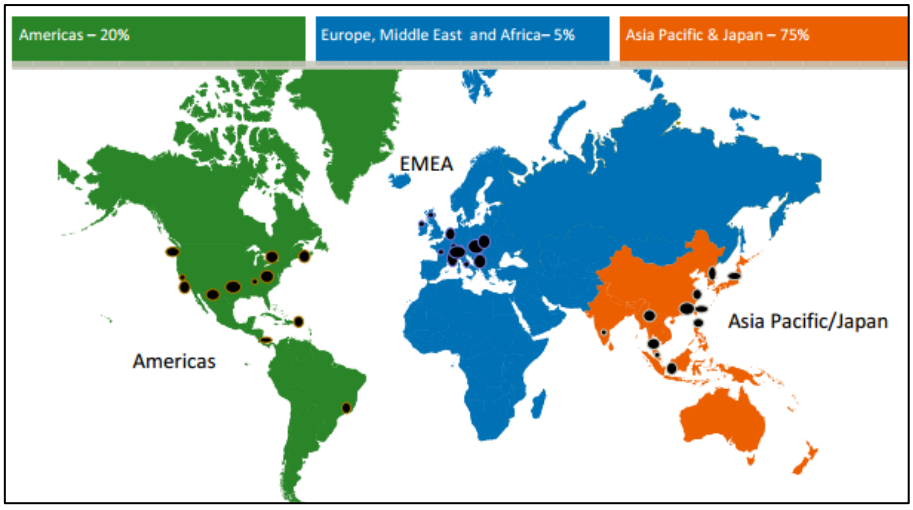
a) Component suppliers

- *Configuration*

HP purchases materials, components and manufacturing for its products from suppliers located worldwide. With over 400 direct material suppliers operating from more than 1,000 manufacturing locations around the world, HP operates one of the largest and most complex IT industry's supply chains (Danish Commerce and Company Agency, 2008). With its $43 billion per year, HP has the largest spend in production materials of the entire computer industry (Carbone, 2004). However, HP has direct contact only with 1st tier suppliers, so the company can only influence the behavior of 2nd and 3rd tier suppliers through the management of its 1st tier suppliers (Van Dijk & Schipper, 2007).
As shown in figure 4.3-4, the largest supplier base in terms of expenditure is located in the APJ region, accounting for 75% of total expenditure. The EMEA region accounts only for 5% of the total

expenditure, while the America region absorbs the 20% of the total spend (Danish Commerce and Company Agency, 2008).

Figure 4.3-4: HP's worldwide suppliers of product materials, components and services



Source: Danish Commerce and Company Agency (2008)

In order to get the best price, the highest quality and the best support possible, the firm has launched initiatives to exercise control of its spend, consolidate its purchases and identify and develop emerging sources of supply in developing countries (Carbone, 2004). As a matter of fact, HP has centralized its purchasing with a small group of suppliers: 80-85% of HP's production spent is in fact with just 35 suppliers (Kumar, 2005). However, for most of its products HP has alternate sources of supply, although it relies on sole sources parts for products with short life cycles. Specifically, HP is dependent upon Intel as a supplier of processors and Microsoft Corporation for various software products.

- *Coordination*

HP has implemented a standardization strategy for handling the procurement of components supply.

- *Standardization*

HP engages in design for commonality and reuse, which involves using similar or identical components in different products (Blanchard, 2007). The standardization of component let the company utilize the same components across the entire product lines and therefore HP can achieve economies of scale through the increase of its bargaining power towards its suppliers. This is also the case of key components, such as memory, processors and hard disk drivers (Supply Chain Council, 2010). This way, the company has managed to control the variety of the products offered and to achieve a reduction of its inventory of 42 per cent moving from 107 modules and 95 product options to 55 modules and 49 options (Cargille, Bear, & Amaral, 2005).

b) HP manufacturing plants/OMs/OEMs

- *Configuration*

HP outsources most of its manufacturing around the world to create HP-designed products; in fact more than 80% of its products are manufactured through alliances and partnerships (Van Dijk & Schipper, 2007). The use of outsourced manufacturers (OMs) is intended to generate cost efficiencies and reduce time to market for HP-designed products (Hongni, 2010).
Moreover, in some circumstances third-party OEMs manufacture products that HP purchases and resells under the HP brand. By outsourcing much of its manufacturing, HP frees up resources to focus on the design and marketing of innovative products (HP, 2011b).
In addition, the firm currently manufactures a limited number of finished products from components and sub-assemblies (HP, 2011b). In total the company is responsible for 32 manufacturing plants (Blanchard, 2007) but it directly operates only the following 15 (HP, 2012e):

- Americas:
  - *Corvallis – Oregon*: inkjet and pen production and testing
  - *San Diego - California*: inkjet and pen production and testing
  - *Houston – Texas*: manufacturing of computing and storage products
  - *Aguadilla - Puerto Rico*: manufacturing of inkjet cartridges, commercial ink, CD/DVD, assembly of printed circuit boards
  - *Campinas - Brazil*: manufacturing of network servers and supply chain management for desktops and notebooks
- EMEA:
  - *Dublin - Ireland*: final assembly and print head manufacture of inkjet cartridges
  - *Rehovot and Kiryat Gat – Israel*: manufacturing of digital presses and imaging products
  - *Caesarea and Ashkelon - Israel*: manufacturing of long format digital printing machines, and manufacturing of solvent and UV based inks
- Asia-Pacific:
  - *Singapore*: manufacturing assembly of HP inkjet cartridges, intermediate assembly and wafer fabrication of HP inkjet print-heads, manufacturing of electronic supplies and substrate certifications
  - *Tokyo - Japan*: manufacturing of computer products
  - *Nagar - India*: manufacturing of computer systems
  - *Shanghai and Chongqing – China:* management of the manufacture of PCs and servers

However, only 10% of the assembly is done by HP production sites, while 90% is outsourced in the following countries: US, Czech Republic, Hungary, China, Brazil, Australia (Van Dijk & Schipper, 2007).

- *Coordination*

HP utilizes two primary methods of fulfilling demand for products: building products to order and modularity.

  - *Build-to-order*

HP builds products to order to maximize manufacturing and logistics efficiencies by producing high volumes of basic product configuration. The inventory management and distribution practices in building products to order seek to minimize inventory holding periods by taking delivery of the inventory and manufacturing immediately prior to the sale or distribution of products to the customers (HP, 2011b).

  - *Modularity*

In order to deliver mass-customized products rapidly, while at the same time continuing to reduce costs, HP has adopted the strategy of modularity (Feitzinger & Lee, 1997). Products are in fact designed around a number of independent modules that can be easily combined in a variety of ways. Modular design provides HP with three primary benefits: firstly, components that differentiate the product can be added during the later stages of production, a method generally called postponement. Secondly, production time can be significantly reduced by simultaneously producing the required modules. Thirdly, producing in modules eases the identification of quality problems (Meredith, 2010).

c) Distributors

- *Configuration*

In order to distribute its products worldwide, HP has adopted an outsourcing strategy by committing with 88 distribution hubs for serving more than 1 billion customers in 178 countries (Blanchard, 2007). In fact, as stated by Frasca, director of global logistics procurement at Hewlett-Packard, Palo Alto, California, "HP will never own warehouses or warehouse management systems or transportation management systems, since it is not a core competence of the company" (Murphy, 2004). John Daniel, the worldwide logistics business process manager at Hewlett-Packard in Palo Alto, California, adds that "globally, HP works with upwards of 40 TPL providers, however only nine to twelve are core partners" (Hannon, 2006). Logistics providers are constantly monitored by HP and they are evaluated based of the following criteria: cost, investment in IT infrastructure, security and innovative thinking (Murphy, 2004). This has let HP strengthen its relationship with logistics providers in order to render more effective the distribution of products worldwide.

- *Coordination*

Hewlett-Packard has adopted the postponement strategy with its distributors for effectively achieving the mass-customization of its products.

  - *Postponement*

Hewlett-Packard relies on the concept of postponement for its laptop build-to-order program to minimize forecasting mistakes and to manage inventory and production. Through this program, HP can provide last-minute customization in accordance with actual demand.
An example of assembly postponement regards HP printers. In fact, printers designed for different global markets are inherently the same product except for country specific power supply modules, power cord plugs, and instruction manuals. HP makes two types of printers in Vancouver: a US version and a generic version that is customized once it reaches a distribution center in Europe, Asia, or the Pacific based on country specific orders (Lee, Billington, & Carter, 1993).
This way, the customer value can be addressed in increased quality and reliability, faster delivery cycles, greater flexibility, and stepwise investment possibility (Karandikar & Nidamarthi, 2007).

d) Retail stores

- *Configuration*

HP sells PCs in about 110,000 stores (Jain, 2008), which has resulted in a high penetration in electronic retailers, being 90 out of the world's top 100 retailers customers (Holloway, 2011).

- *Coordination*

HP has developed two main strategies with its resellers for treating them more like corporate customers rather than retailers. These are the built-to-custom-order (BTCO) and the configure-to-order (CTO) strategies.

  - *Built-to-custom-order (BTCO)*

The built-to-custom-order (BTCO) concept allows consumers to order custom laptops directly from the factory while letting HP reduce the channel inventory for its products by providing only a few actual systems to retail outlets as demos. Customers use the demos at the retail stores to get a hands-on idea of the laptops, and then order custom versions for themselves using online kiosks set up by the retail outlets and linked to HP's retail website.
All BTCO orders are built and shipped directly from contract manufacturers factory in Taiwan, with domestic rush orders available through express carriers. HP has committed with FedEx for shipping the BTCO laptops within a week of the order being placed, with shipment from Taiwan to the client site completed with two to three days for a total of 10 days lead time (Best Practices Llc, 2002).

The BTCO program has brought several benefits to HP: besides encouraging consumers to explore and purchase the range of laptop options and configurations offered by the company, it also greatly reduces the number of actual laptop units needed to be shipped to retail stores. Moreover, BTCO allows HP to upgrade its portfolio of consumer laptop features more rapidly, with less concern for outdated configurations that could be still sitting on retail store shelves. In addition to the advantages for HP, retail outlets have benefited of the BTCO program as well, through lower inventory.
As a result, HP experienced a 20 percent increase in order quality, since fewer touches occur in the supply chain process (Best Practices Llc, 2002).

- *Configure-to-order (CTO)*

HP has adopted a configure-to-order program (CTO) with its resellers, which makes them much like a corporate customer. HP has in fact set up extranet sites for its resellers to be able to order HP PCs and other products the same way that consumers do. This has let HP pass the inventory management burden on to the resellers, whom HP believes are better equipped to do so since the resellers are closer to the end users (Kumar, 2005). Moreover, the CTO program allows HP-authorized resellers to configure the models available to the exact specification required and place the orders through a chosen distribution partner.

e) Final customers

HP addresses its products offering to a wide range of customers, varying from individual consumers, small- and medium-sized businesses (''SMBs'') and large enterprises, including public customers. However, no single client represents 10% or more of HP's total net revenue (HP, 2011b). In order to deliver the final product to its customers, HP utilizes both a direct and an indirect distribution method. The indirect channel handles the majority of the sales for domestic consumers and SMBs, and as previously presented, it comprises distributors and retailers. The direct channel instead, differs depending on whether customers are large enterprises and public or whether they are domestic consumers and SMBs. In the first case, HP sales representatives, "Enterprise Sales", deal with the selling of HP products, while domestic consumers and SMBs can bypass the retailer channel by purchasing HP PCs on the hp.shopping.com website. The two channels will be separately presented.

i) Enterprise Sales

- *Configuration*

HP adopts Enterprise Sales teams for managing most of its enterprise and public sector customer relationships. Their primary responsibility is to simplify sales process across HP market segments in order to improve speed and effectiveness of customer delivery (HP, 2011b).

- *Coordination*

HP has implemented the configure-to-order (CTO) program in order to allow corporate customers to configure their products on HP website before buying them.

- *Configure-to-order (CTO) for corporate customers*

HP has implemented a CTO strategy with corporate partners in order to let companies configure their electronic equipment based on their specific needs. Corporate customers can in fact personalize their HP equipment through flexible configurations available on HP website. The products are then delivered to the company facility directly from the factory with no intervention from third parties. Thanks to the complete customization of products, the CTO method allows corporate customers to more easily integrate the new HP equipment with their current work environment (Compaq, 2012).

ii) Hpshopping.com

- *Configuration*

Hpshopping.com was launched in 1998 and it has experienced revenue growth of over 500% annually (FedEx, 2006). The hpshopping.com website however, is only available in US, in fact in EMEA and in Asia the online purchase of an HP product is only possible through an HP e-commerce partner.

- *Coordination*

Dell has partnered with FedEx for effectively implementing its direct distribution channel.

- *Partnership with FedEx*

In order to implement the direct sale of products to final customers, HP partnered with FedEx for developing the online direct channel through hpshopping.com.
HP utilizes the FedEx fulfillment center in Memphis as a warehouse for its direct sales in US so it can outsource the management of the inventory to the logistics company. Once the customer has placed an order online through hpshopping.com and the customer's credit has been authorized, an e-mail confirmation is sent to the customer. Then the order is transmitted to the FedEx fulfillment center in Memphis, where the order is picked, packed, and shipped directly to the customer. At this point, an e-mail shipment notification is sent to the customer from hpshopping.com, alerting the customer that the shipment is in transit. During the ordering process, the shipment status and order tracking is available at hpshopping.com (FedEx, 2006).

4.3.3. Reverse supply chain

In 2011, HP recovered 295 million pounds of hardware and supplies, reaching a milestone of responsibly recycling two billion pounds of electronic products and supplies since 1987. This has been possible thanks to the implementation of recycling programs in 60 countries worldwide which has resulted in a total reuse and recycling rate of approximately 15% of relevant HP hardware sales worldwide in 2011 (HP, 2012c).

4.3.3.1. General structure

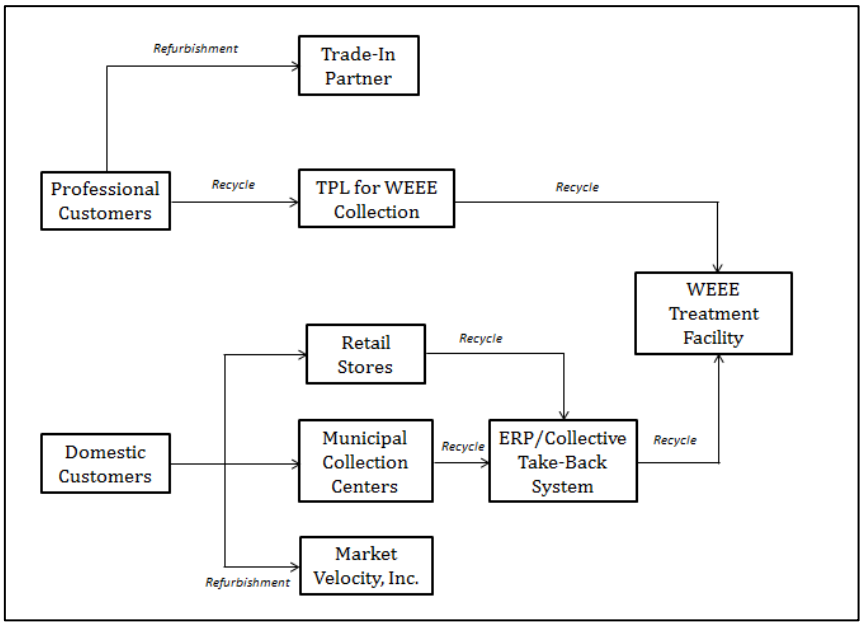
HP works with a global network of vendors in 67 countries and territories worldwide to collect, process for resale, and/or recycle returned products, as well as qualify recycled materials for use in new products (HP, 2011a).

HP reverse supply chain differs depending on the type of return. Demos, commercial and leasing returns are handled by special HP Asset Recovery Service Teams, which organize their collection and transportation to an HP Technology Renewal Center. Here the conditions of the products are assessed and then they are evaluated for refurbishment. Refurbished products, which need to be less than 12 months old, are then sold through the HP Renew Sales Teams.

These flows are however only a marginal part of the returns, since the majority represents EOL products (HP & ERP, 2012). EOL products are not considered for refurbishment, since it would cost too much for HP to refurbish and provide a new warranty for them. Moreover, refurbishing a used product and reselling it with the HP name might cause problems in terms of reliability of products, data security and cannibalization of the mainstream business. In fact, as stated by the HP manager interviewed, “it is far too complicated to refurbish and resell HP EOL products, since HP sells high-quality products” and therefore it has to assure customers that PCs are made with best quality components (HP & ERP, 2012). As a consequence, the majority of EOL PCs is deemed for recycle by HP; although professional and domestic customers can still ask either for a trade-in option (professional customers) or for a buyback option (domestic customers) to an external partner of HP for getting some value back from the used equipment.

As highlighted by figure 4.3-5, the collection process for HP EOL computers differs depending on the type of customer returning the equipment, distinguishing between professional customers and domestic customers.

Figure 4.3-5: HP Reverse Supply Chain for EOL Computers



Equipment for professional use is in most of the cases collected by an external logistics partner authorized for collecting the e-waste and it is directly delivered to an external treatment facility for properly recycling the waste. Alternatively to this, HP offers a trade-in option for professional clients by partnering with an external company.

On the other hand, domestic consumers can ask for a trade-in option to an external partner of HP, otherwise bring their EOL product either to a retailer, when buying a new product, or to a municipal collection center for proper recycle. From here, a collective system is responsible for collecting the waste and delivering it to a treatment facility. For this purpose, HP has co-founded ERP, which is a pan European collective system responsible for handling the WEEE collection.

4.3.3.2. Reverse supply chain strategy

HP has completely outsourced the recycle process both for professional and for domestic customers, although there is a tight relationship between HP and ERP. HP is in fact a shareholder of ERP and therefore, being part of the board of directors, it can take decisions on behalf of ERP. ERP however is not considered as a division of HP but as an external entity responsible for effectively collecting the e-waste on behalf of HP.

Due to the different return flows, HP's professional and domestic returns will be discussed in separated sections.

4.3.3.2.1. Professional EOL returns

In order to manage the returns of professional EOL computers, the HP Financial Services Division has setup an Asset Recovery program for helping business customers disposing of their WEEE. Professional customers can in fact either recycle the equipment through HP or ask for a trade-in option, where the condition of the equipment is assessed by an external partner and if considered for refurbishment, a value is given back to the professional client. This second option represents however a marginal part of the total products recovered since almost all of them are deemed for recycle by HP. The recovery process for the two alternatives is presented.

a) Trade-in partner

- *Configuration*

HP has set up a trade-in option for professional clients when changing their old equipment with HP brand new products. The used equipment can in fact be assessed by an external partner for refurbishment or components reutilization, and if some value can be extracted from the old equipment, this is given back to customers. HP has partnered with several companies for handling the trade-in option, in Italy, for example, the process is managed by CFC Italia S.r.l. (HP, 2012d). However, the majority of clients does not consider the trade-in option, preferring instead to recycle the used equipment. This is due to the fact that professional clients are highly sensitive to private data recorded in the PCs and therefore they want to be sure that their equipment is properly recycled (HP & ERP, 2012).

- *Coordination*

  - *Outsourced process*

The trade-in process has not to be considered as part of HP business, in fact as explained in the interview with HP, "the trade-in process is promoted and financed by HP but the organization acquiring the used products is a third-party that has nothing to do with HP. It can be seen as a service that HP offers to professional customers when changing their equipment, but the process is not managed by HP" (HP & ERP, 2012).

b) TPL for e-waste collection

- *Configuration*

As previously stated, the majority of EOL products collected at the client's site is sent for recycling. For this purpose, HP has partnered with an authorized TPL company which collects the e-waste at the client's site and transports it directly to a treatment facility for recycling the material. The entire

process is strictly controlled by HP, which needs to be sure that the equipment is properly recycled since computers might contain sensitive data for clients.

- *Coordination*
    - *Screening handled by the customer*

Since HP has completely outsourced the recovery of used products to external partners, it has not been implemented a screening gate for the returned products; it is in fact the customer the one screening them. This means that customers take the responsibility of deciding whether to recycle the equipment or whether to ask for the trade-in option. However, since the clients do not have the capabilities for properly assessing the condition of the equipment, it might happen that products which could be reutilized or refurbished are instead erroneously sent for recycling.

c) WEEE treatment facilities

- *Configuration*

The process undertaken by HP products in the e-waste treatment facilities is the same as the one described for Dell, since the process is outsourced to external partners which in most of the cases treat waste independently on the brand.

- *Coordination*
    - *Design for recycle*

In order to facilitate the recycle of products, HP has adopted a design for recycle strategy, starting from the early stages of development of a product. As an example, HP uses common fasteners and snap-in features avoiding applying glues, adhesives, or welds where feasible for helping recyclers to more easily remove labels from returned products. Moreover, by designing products for easing the disassembly activities, HP has facilitated the separation and identification of different plastics. Overall, HP has achieved the result that most PCs are more than 90% recyclable (HP, 2011a).

4.3.3.2.2. Domestic EOL returns

Customers returning a domestic EOL PC have three possible options. A first possibility is to bring the product back to a retailer when buying a new one; an alternative is to bring the used equipment to a recycling center, and the last option, although available only in US, is to adhere to the Consumer Buyback program which has been launched by HP in partnership with Market Velocity, Inc., in order to let customers get some value out from their used equipment. Except for this last option, HP does not screen the domestic products, deeming all of them for recycle.

a) Retail stores

- *Configuration*

Following the WEEE directive, in Europe consumers must be able to return their old equipment free of charge to retailers when buying new electronic equipment, the so called "one against one" regulation. In addition, retailers must provide information to their customers about how they can do this, and are responsible for establishing take-back schemes, either in-store or at common collection points (European Commission, 2012). The WEEE directive gives also the faculty to retailers to organize the collection of WEEEs in "Grouping Centers" managed directly by retailers (Directive 2012/19/EU). Otherwise, retailers can contact a collective system for waste recycling which is responsible to take back the electronic equipment free of charge from retailers to WEEE collection centers. As a result, HP does not directly collect the waste at the retailer site, but a specific collective system deals with it.
In US, HP has partnered with Staples in order to let customers bring any of their e-waste to a Staples location, which assures HP 1,552 collection points in US (HP, 2012c).

- *Coordination*

  - *Outsourced collection process*

HP does not have any contact with retailers for the screening of the products for possible equipment refurbishment or components reutilization. All the products collected are in fact sent to a treatment facility for recycling (HP & ERP, 2012).

b) Municipal collection centers

Another option for customers when deciding to recycle their EOL electronic equipment is to deliver it to a recycling center. The process is the same as for Dell (section 4.2.3.2.2.d).

c) ERP – Collective system for recycling

- *Configuration*

As explained in Dell's section, equipment at the municipal collection centers and at the retailers' sites are collected by collective systems for recycle and delivered to a specific treatment facility.
In Europe, HP has cofounded the European Recycling Platform (ERP), which provides pan-European take-back and recycling services. ERP was founded in December 2002 by Braun, Electrolux, HP and Sony in response to the introduction of the European WEEE Directive. The ERP's mission is to ensure cost effective implementation of the directive, for the benefit of the participating companies and their customers, through innovative waste management strategies and to encourage national implementation of the regulation according to a set of core principles, fundamental to the protection of

consumers and businesses, as well as the environment (Gosnell, 2003). ERP is in fact a non-profit company and therefore the entire margin generated is not distributed to shareholders as dividends but is reinvested into cost reduction for participants and into public awareness campaigns for sensitizing customers (HP & ERP, 2012).
ERP outsources all operational activities to two general contractors which must always achieve the best competitive price. The general contractors design, establish, operate and manage all the operations related to the take back process.
Through ERP, HP can offer compliance directly in twelve countries: Austria, Denmark, Finland, France, Germany, Ireland, Italy, Norway, Poland, Portugal, Spain and the UK, reducing the cost of the implementation of an individual reverse supply chain.
As a result, ERP recycled 40,000 tonnes of e-waste on behalf of HP in 2011 (HP, 2011a).

- *Coordination*
    - *Non-profit organization*

ERP was funded in order to optimize the costs for the producers financing it and not for gaining profits as the other collective systems do (HP & ERP, 2012). As a consequence, HP has a cost-advantage compared to the other companies competing in the computer industry, since they pay higher costs for the e-waste collection.

d) Market Velocity, Inc.

- *Configuration*

In US, HP has launched the HP Consumer Buyback and Planet Partners Recycling Program which is a service provided to HP customers by partnering with Market Velocity, Inc. (MVI). Through this program, customers can get a buyback quote for their used equipment; if the product has no buyback value, the customer is given the option to recycle. For the buyback option, completion of the claim includes the receipt and inspection of the product. The customer is then given three options for payment of the Buyback amount: cash back check, HP gift card, or donate the Buyback amount to an HP approved charity. It takes up to 45 days from the time the buyback claim is completed for receipt of the cash back check (HP, 2012a).

- *Coordination*
    - *Outsourced program*

The HP Consumer Buyback and Planet Partners Recycling Program is completely outsourced to MVI, in fact HP is not involved in individual transactions between Market Velocity and HP customers. Any and all transactions conducted on the MVI site are solely the responsibility of Market Velocity and such visitors (HP, 2012a).

5. Findings

After having presented the forward and reverse supply chain of Dell and HP, in the finding section the two companies are compared based on supply chain KPIs in order to understand how their supply chain decisions in the forward and reverse supply chain have an impact on their performance. This will set the context for afterwards identifying the strategies adopted by the two companies for managing the dual business model of the forward and reverse supply chain.

5.1. KPIs

As explained in the methodology section, the strategies adopted by Dell and HP for managing the dual business models are evaluated based on KPIs derived by the decomposition of the ROA index. The decomposition of the ROA is carried out in order to compare the profitability, through the profit margin ratio, and the asset management efficiency, through the asset turnover ratio, of the two companies. The two aspects will be therefore discussed separately. The figure below shows the results of the KPIs.

Figure 5.1-1: KPIs comparison for HP and Dell

	DELL	HP
PROFIT MARGIN		
Operating Income		
Forward Supply Chain		
Lead time	5 days	10 days
Reverse Supply Chain		
Repair turnaround time	17 days	30 days
Recovery rate	10%	81%
Operating Expenses		
Forward & Reverse Supply Chain		
Gross margin as % of sales	22.25%	23.35%
SG&A sales ratio	13.73%	10.58%
ASSET TURNOVER		
Current Assets		
Forward & Reverse Supply Chain		
Inventory days	10.23	26.20
Receivables days	38.13	52.64
Payables days	86.78	54.65
Cash Conversion Cycle	***-38.42***	***24.19***
Fixed Assets		
Forward & Reverse Supply Chain		
PP&A productivity	30.45	10.58

PROFIT MARGIN			
DELL		HP	
3rd Feb 2012	28th Jan 2011	31st Oct 2011	31st Oct 2010
5.88%	4.39%	5.99%	7.27%

ASSET TURNOVER			
DELL		HP	
3rd Feb 2012	28th Jan 2011	31st Oct 2011	31st Oct 2010
1.49	1.70	1.00	1.05

RETURN ON ASSETS			
DELL		HP	
3rd Feb 2012	28th Jan 2011	31st Oct 2011	31st Oct 2010
8.78%	7.47%	6.00%	7.66%

5.1.1. Profit margin

Profit margin is a key financial indicator used to assess the profitability of the company; in fact it measures how much of each dollar earned by the company is translated into profits. The profit margin value provides clues to the company's pricing policies, cost structure and production efficiency.

As highlighted in figure 5.1-1, HP has gained a higher profit margin compared to Dell in the last two fiscal years, although in FY2011 its performance has declined compared to FY2010. HP's profit margin was in fact 5.99% against 5.88% of Dell in FY 2011 and 7.27% against 4.39% of Dell in FY 2010.
In order to better understand by which strategic decisions does this result depend, the *gross profit margin* and the *SG&A sales ratio* are used as indicators for assessing both the manufacturing and distribution efficiency during the production process, in the first case, and the marketing and management expenses for the two companies, in the second case. Moreover, the *lead time* of the two companies will be compared, as a measure affecting the satisfaction of customers and thus the revenues. Finally the two companies will be assessed based on their performance in activities involving the reverse supply chain, which affect both the revenues gained by selling a higher number of refurbished products and by increasing the satisfaction of customers through the repairing activities, and the costs associated to a higher number of products recycled. The *recovery rate* and *the repair turnaround time* will be used as indicators for this purpose.

Regarding the *gross profit margin,* HP performs better compared to Dell (23.25% compared to 22.25% of Dell) and this might be due to a better control of costs thanks to economies of scale derived by a broader product portfolio. The company has in fact based its competitive advantage on a differentiation strategy, which has allowed it to sell high-value products in different segments of the high-tech industry resulting not only in gains in terms of lower production costs and component sourcing costs but also in higher brand value. As a matter of fact, while 53.6% of total Dell's revenues are attained through the selling of client products (mobility computers and desktop PCs), only the 30.4% of total HP's revenues can be related to the selling of notebooks, desktops and workstations. In addition, HP has implemented supply chain strategies for reducing both the procurement costs for components, with the standardization of components (as explained in section 4.3.2.2.a), and the distribution of products, by initiating built-to-custom-order (BTCO) activities together with retailers. On the other hand, also Dell has initiated supply chain activities for increasing its manufacturing and distribution efficiency. This has been done by cutting procurement costs by augmenting the sourcing of components from low-cost country, especially Asia and Eastern Europe. Moreover, as stated in the annual report of the company, Dell has also improved the profitability of its client products by simplifying the product offerings and by shifting Dell's revenue mix to higher-value products (Dell Inc., 2012a), while entering in the lower price segment with the refurbished products.

Regarding the *SG&A sales ratio*, selling, general and administrative costs represent the 13.73% of revenues for Dell, while only 10.58% for HP. The high value for Dell is mainly due to the high costs paid for advertising brand new and refurbished products to consumers and for the field sales force used for selling products to professional clients. Moreover, as stated by Dell's annual report, the year-

over-year SG&A expenses increase is highly attributable to restructuring activities implemented by Dell for strategically transforming the company. These strategic initiatives have entailed organic investments in enterprise solution selling capabilities and other infrastructure spending as well as investments in enterprise and services-focused acquisitions, which generally have higher expense structures. Moreover, in 2012 the company has unified its global sales and marketing teams in an effort to create more responsive and efficient sales organizations (Dell Inc., 2012a). As a result of these changes, a more efficient handling of the marketing and administrative activities is expected for the upcoming years. On the other hand, HP has managed to maintain a fairly low level of SG&A expenses thanks to its broad portfolio of products which lets the company share marketing and administrative resources between the various business segments. Moreover, in 2011 the increase in SG&A expenses, due to investments in sales resources with the goal to grow revenues, has been partially offset by the sale of real estate and the divestiture of HP's Halo video collaboration products business (HP, 2011b).

Besides a better control of the operating expenses by HP, Dell can increase the satisfaction of its customers and therefore sustain its revenues by better handling the products' flows along its forward supply chain compared to HP. Dell's *lead time* is in fact around five days (Monczka, Handfield, Giunipero, & Patterson, 2009), compared to the ten days required by HP for delivering a product to consumers from the day of its request (Best Practices Llc, 2002). Dell's result is highly dependent on the implementation of a lean supply chain which stands at the basis of its competitive advantage. This has been possible also thanks to the virtual integration strategy adopted by Dell which has enabled the company to achieve both coordination and focus with its partners. Dell's strategy has transformed the organization in a network company where every partner is committed for the benefit of the whole system. This reduces the risk of opportunistic behavior by the players in the supply chain resulting in better information sharing that helps in reducing the overall lead time for the chain. This is for example demonstrated by the development of revolvers closed to Dell's assembly plants. As explained in section 4.2.2.2.a, these are warehouses where Dell's suppliers stock the inventory for Dell's products and share the cost of the rent. As a result, the sourcing time for Dell is around 90 minutes (Magretta, 1998), compared to the 24 hours for HP (HP, 2012b). Moreover, Dell has also implemented lean supply chain techniques in its assembly pants for both brand new and refurbished products, which let the company assemble a computer in a maximum time of eight hours (Kumar & Craig, 2007).
On the other hand, it takes around five days more for HP to deliver its products to customers from their request. This is due to the presence of the retailer stage, which increases the difficulty in forecasting the demand and therefore hampers HP when forecasting the supply needed. However, in order to reduce its lead time, HP has introduced the built-to-custom-order (BTCO) program which allows individual consumers to use the direct channel through the retailer, as emphasized in section

4.3.2.2.a. Moreover, the implementation of postponement strategies with its distribution centers has allowed HP to reduce the lead time of its products by simultaneously augmenting the customization of them.

The profit margin of HP and Dell is also in minimal part affected by the reverse supply chain activities of the two companies, due to the low relevance given by HP and Dell to them. For HP the reverse supply chain is considered as a source of cost, and therefore the strategies implemented by the company are directed towards the reduction of the costs associated to it. This has been evident by the foundation of ERP, which lets the company reduce the costs related to the collection and recycle of products. On the other hand, although the reverse supply chain activities entail high costs also for Dell, the company is also gaining revenues from the selling of refurbished products. As a matter of fact, in the period 2007-2009 Dell has gained $2 million in revenues only by selling refurbished products via Twitter (Miller, 2009). This has resulted both in a reduction of costs related to recycle activities, due to the less number of product recycled, and in an increase in revenues thanks to the selling of refurbished products. In fact, in 2011 HP has recycled 295 million pounds of hardware and supplies with an 81% *recovery rate* (HP, 2011a), while Dell has recycled around 150 million pounds of returned products, resulting in only 10% *recovery rate* (Dell Outlet, 2012). The recovery rate identifies the number of units scrapped over the total number of products put into the reverse stream in a period of time (PricewaterhouseCoopers, 2008), so it is evident that Dell has a much higher involvement in re-sale, repair and refurbishment activities compared to HP. This is also highlighted by the lower *repair turnaround time* of Dell compared to HP. In average, it takes only 17 days for Dell to repair a computer (Jacobs, 2003), compared to the 30 days of HP (HP, 2009). This might be due to the preponement strategy adopted by Dell for reducing the repair returns. As highlighted in section 4.2.3.2.2.a, before returning a product for repairing, consumers are guided by a technical customer service representative contacted by phone through set-up and early usage issues in order to solve simple problems without returning the product.

HP is therefore more profitable than Dell and this is mainly due to the differentiation strategy of HP which, by offering a broader product portfolio, allows the company to gain economies of scale and strengthen its brand equity thanks to higher brand recognition. However, the profitability performance of the company has declined of almost 1.3 percentage points in FY 2011 compared to FY 2010, while Dell's profitability has increased of almost 1.5 percentage points in FY 2011 compared to FY 2010, as a result of the structural changes implemented by the company.

5.1.2. Asset turnover

Asset turnover is the second financial indicator composing the ROA together with the profit margin and it measures a firm's efficiency at using its assets in generating revenue.
As highlighted in figure 5.1-1, Dell's asset turnover results 1.49 compared to 1.00 of HP in FY 2011 and 1.70 compared to an asset turnover of 1.05 for HP in FY 2010. Dell is therefore managing more efficiently its assets compared to HP, however a decomposition of the indicator is necessary for understanding the reasons behind Dell's higher asset efficiency. The asset efficiency of the two companies needs therefore to be compared in all the three major asset subclasses: fixed-asset efficiency, inventory days and receivable days.

The *fixed asset efficiency* of the two companies is measured by calculating the PP&A turnover, which identifies how efficiently companies generate revenues from properties, plants and equipment. Dell's fixed assets are much more efficient than the ones of HP; the Round Rock company in fact generates $30.45 in revenues for every dollar invested in PP&E compared to only $10.58 for HP. This might be a consequence of the virtual integration strategy adopted by Dell. Dell has in fact implemented such strong relationships with its suppliers that the company does not manufacture any of its products. Dell does in fact only assemble its products in its six assembly plants located in low-cost areas around the world. Evidence of this strategic choice was the decision to move all its EMEA activities from the historical Limerick plant in Ireland (which was the first Dell's affiliate to be set up outside US in 1989) to the lower-cost assembly plant in Lodz (Poland) in January 2009. With this shift, Dell employed people to carry out the same job in Poland at one-third of the costs of employing them in Ireland (Collins & Grimes, 2011). On the other hand, HP directly manages only 10% of the total assembly processes but also 20% of the total manufacturing processes in its 15 manufacturing plants around the world. These are however not always located in low-cost areas, which results in higher assets costs, as it can be the case for the plants in US, Singapore, Japan, Ireland and Israel.

Inventory days measure how quickly a company converts its inventory into sales. It takes only 10.23 days for Dell to convert its inventory in sales, while for HP the days are 26.20. Dell is a model for companies in the computer industry in terms of its inventory management. By sharing real-time demand information with its suppliers, Dell can reduce the inventory needed and better forecast the demand for component supplies. Moreover by employing a vendor managed inventory strategy, Dell does not take possession of the inventory until the parts enter the Dell plant, but they are instead stocked in the revolver. Finally, Dell manages also to shape the demand for consumers in order to match customers demand with inventory levels by running promotions on products with high inventory levels. HP on the other hand does not have much freedom on its inventory levels due to its indirect distribution channel. The company has however implemented programs with retailers, like

the built-to-custom-order (BTCO) and the configure-to-order (CTO) programs, for reducing its inventory. The BTCO program lets HP reduce the channel inventory of HP's laptops by allowing consumers order custom HP laptop computers from the retailer's site. With the CTO program HP has instead passed the inventory management burden on to the retailers by setting up extranet sites for its resellers to let them order HP PCs and other products the same way that consumers do.

Account receivable days measure the average number of days that it takes for a company to collect revenue after a sale has been made. It takes an average of 38 days for Dell to turn its sales into cash, while around 53 days for HP. Dell is therefore more liquid than HP and this might be due to the fact that most of Dell's sales happen on the internet through a direct channel which results in an immediate receipt of credit. On the other hand, HP distribution channel involves the presence of distributors which cause delays in cash conversion of sales.

Account payables days are also compared in order to determine the cash-conversion-cycle of the two companies. It takes an average of 87 days for Dell to pay its creditors, compared to the 55 days for HP. By calculating the cash-conversion-cycle (CCC) for Dell and HP it is easy to notice that Dell manages to turn sales into cash before paying its suppliers, as highlighted by the negative CCC (-38 days), while HP has a positive CCC of 24 days, which means that it takes much more time for HP to convert its resource inputs into cash flows compared to Dell.

Dell therefore generates superior asset efficiency in all the major asset subclasses compared to HP, which results in an asset turnover of 1.49 compared to 1.00 for HP. This result is highly dependent on the supply chain strategies implemented by Dell for rendering both its forward and reverse supply chain as lean as possible.

5.1.3. Return on assets (ROA)

Return on Assets (ROA) indicates how profitable a company is relatively to its total assets. By multiplying the profit margin with the asset turnover for the two companies, it is evident how Dell gains higher returns on its assets, 8.78%, compared to HP, 6.00%, in FY 2011. Dell has seen an increase of its ROA compared to FY2010, when the ROA was of 7.46%, and this is mainly due to an improvement in the profitability of the company thanks to initiatives apt to simplify the product offerings, while shifting the demand towards higher-value products, and to reduce production and procurement costs. On the other hand, HP has viewed a reduction of its ROA from 7.66% in FY 2011 to 6.00% in FY 2010, due to a reduction in profitability. This has mainly been caused by lower than expected revenues in some business segments, and in higher production and logistics costs also due to the earthquake and tsunami in Japan, where HP owns a plant (HP, 2011b).

It is however evident that while the differentiation strategy of HP helps the company in supporting its profit margin by gaining in economies of scale through the sharing of resources between business segments, it also reduces the asset management efficiency of the company. By in fact having the largest supply chain in the high-tech industry and the ninth largest industrial supply chain in the world, HP has difficulties in implementing an agile supply chain and this causes inefficiencies to the company.

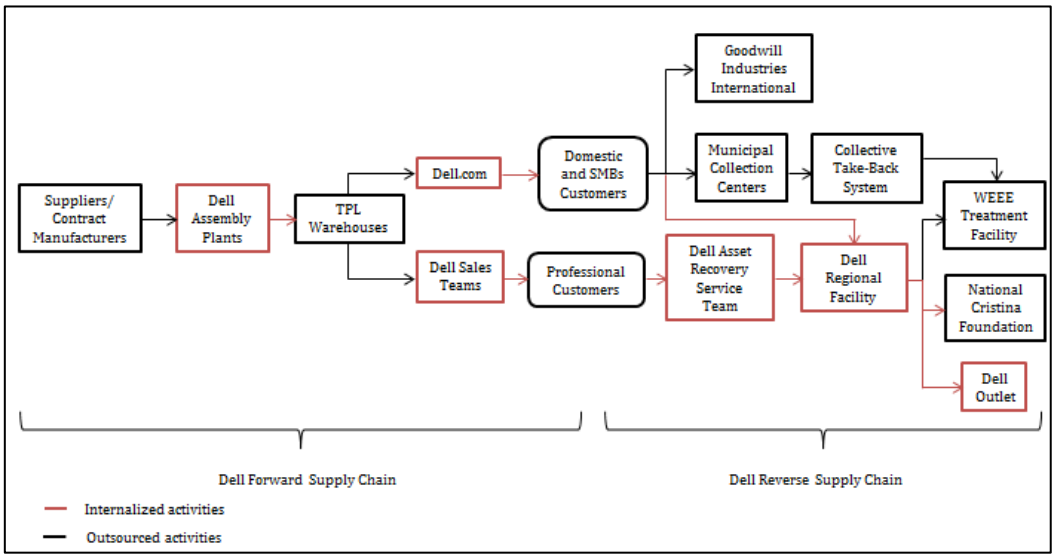
5.2. Strategies adopted by Dell and HP for managing the dual business model

Based on the information gathered and presented in the discussion section, it is now possible to identify the strategies adopted by Dell and HP for handling the dual business model of forward and reverse supply chain.

5.2.1. Dual business model strategy adopted by Dell

After having analyzed the forward supply chain and the reverse supply chain of Dell, it is possible to state that the company is adopting a dual strategy for managing the two business models. The picture below highlights this.

Figure 5.2-1: Dell's Supply Chain



While Dell has completely outsourced the return processes for the products appointed to recycle or scrap, due to the high cost and the low return of value associated to them, it has on the other hand internalized the return processes for products appointed for reuse/refurbishment or components reutilization and integrated these activities with activities in the forward supply chain. The employment of two strategies for the different types of returns has been possible thanks to an effective screening process for both the business and the consumer returns at the earliest stage of the return

process, the so called preponement strategy, which allows the company to reduce the costs associated to the return of unvalued products.

5.2.1.1. Outsourcing strategy

An outsourcing strategy has been adopted by Dell for managing the returns of products deemed to recycle or scrap. Dell in fact is not handling activities related to the collection, transportation and recycle of domestic and professional products which have not been positively assessed for reuse. Notwithstanding this, a smart strategy has been implemented by Dell for reducing the costs associated to the collection of products. By in fact partnering with charity foundations, like Goodwill and NCF, the company has largely increased its collection points all around the US and has consequently transferred the collection costs to these entities while gaining an increase in corporate image. As a consequence, this has resulted in a lower number of products delivered to recycling centers, reducing therefore the costs associated to the recycle of products. Moreover, in order to reduce the number of products recycled, Dell has implemented techniques in the forward supply chain for extending the life of its PCs. The transportation of e-waste from collection centers to treatment facilities has also been outsourced to dedicated collective systems to which Dell pays an annual fee dependent on the level of waste produced. Finally, the e-waste recycle activities have been outsourced to external treatment facilities, however Dell cooperates with them for facilitating the recycle of its products. As a matter of fact, Dell designs its products in a way that reduces the challenges for recyclers, by for example easing the disassembly and the separation of components and by eliminating glues and adhesives which are difficult to be removed. Dell in fact believes that zero waste is an ethical and cost-efficient approach that the company should aim for, and as a result, it has achieved a recycle and reuse rate of 98 percent in 2012 (Dell Inc., 2012d).

5.2.1.2. Integration strategy

Products deemed for reuse, refurbishment or component reuse, follow a process which is not only under the direct control of Dell but which is also integrated with activities in the forward supply chain. A first evidence of this regards the collection of EOL products. Professional clients do not have to contact special recovery teams for recovering their EOLs but they can address to their usual Dell representative. This, besides reducing the costs for Dell associated to the implementation of a specific asset recovery team, increases the level of trust of the client towards Dell, which is a really important issue when managing used computers of business customers for data wiping. As a result, Dell has gained a 96% overall customer satisfaction rating for its Asset Recovery Service program (Dell Inc., 2006a). Furthermore, domestic returns to Dell's facility are in the majority of the cases handled by FedEx, which besides being the mayor logistics partner for the forward supply chain of consumer

products, it also plays an important role in the recovery of used products from individual customers. This creates economies of scopes for Dell by utilizing the same TPL provider for both the forward and the reverse logistics activities.

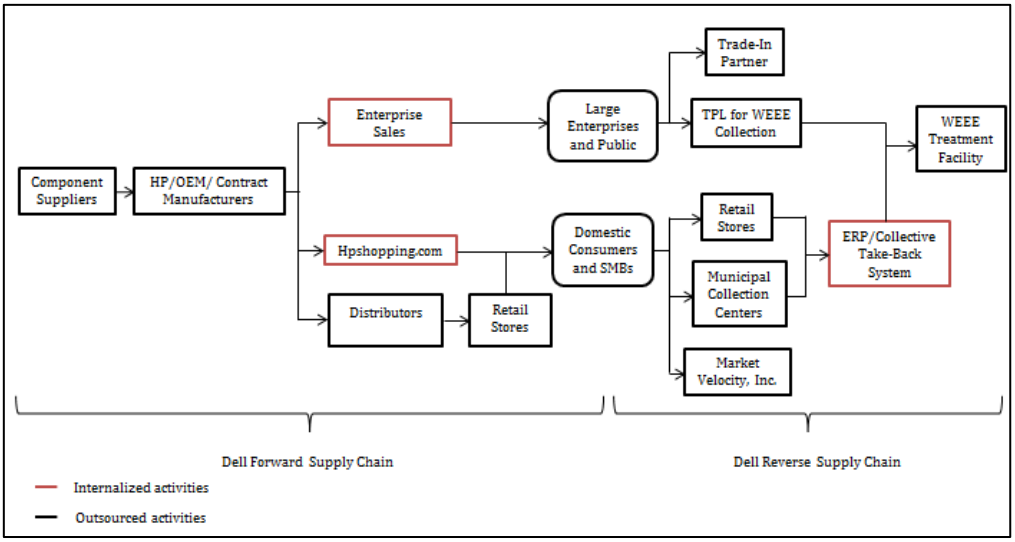
Also the refurbishment of returned products is directly handled by Dell in facilities owned by the company. Dell has adopted integrated design solutions when thinking about brand new products. In order to increase the synergies between the forward and the reverse supply chain Dell does in fact design products for easy disassembling. This strategy, besides facilitating the upgrade of products for extending their life, helps the company reducing the time spent for the disassembly process and maximizing the reutilization of components. An example of this is the modularity technique employed by Dell, which does not only benefit the forward supply chain by easing the integration of components during the assembly process, but it also has an impact on the reverse supply chain by facilitating the removal of modular parts.

Finally, Dell has also integrated the distribution channel of the two businesses. The Dell Outlet website is in fact directly accessible from the Dell.com website. This, while letting customers decide whether to buy a brand new product or a refurbished one, shows also that the company has managed to reduce the conflicts related to the cannibalization between the two businesses, by considering them not as conflicting businesses but as an opportunity for the company to enter in new market segments.

5.2.2. Dual business model strategy adopted by HP

On the other hand, HP is adopting an outsourcing strategy for managing the returns of EOL computers. Although the company has developed refurbishment centers for commercial returns less than one year old and cofounded ERP with which it maintains tight relationships, it has completely outsourced all the activities related to the reverse flow of EOL PCs, as demonstrated in the figure below.

Figure 5.2-2: HP's Supply Chain



5.2.2.1. Outsourcing strategy

Besides the agreement with Staples in US for collecting HP EOL products, the company has not organized independent collection points for the EOLs. Moreover, in order to reduce the costs associated to the refurbishment of PCs, the company does not screen the returns for assessing their conditions and evaluating the possibility of refurbishment, but it deems all of them as waste. As a matter of fact, it is not HP the one screening the returned products, but the customer itself. Both professional and domestic clients can in fact ask for a trade-in option for the used equipment; however the process is entirely managed by an external partner of HP with no intervention by the producer. Once products have been collected, they are transported to a treatment facility for recycle. While in the case of professional EOLs HP has outsourced the transportation process to an external TPL provider, for domestic returns HP has participated in the foundation of a collective system, ERP. Although HP views this collective system as an external company, it has tight relationships with it, as being one of its main shareholders. This assures cost savings associated to the collection of the waste compared to the competitors.

EOL equipment is then delivered to treatment facilities for proper recycle. HP does not have any contact with them, since it is the collective system the one deciding with which player to cooperate. Although the process is completely outsourced to external partners, Dell has adopted operational decisions in the forward supply chain for facilitating the recycle of products. By in fact designing for recycle, for example by using common fasteners and snap-in features or by facilitating the separation of plastics, Dell helps recyclers to more easily handle the recycle process. This has resulted in PCs which are more than 90% recyclable.

In conclusion, as explained by the HP manager interviewed (HP & ERP, 2012), HP has decided to outsource the entire reverse supply chain processes for EOL products, since the cost for refurbishing and for assuring new warranties to EOL products is assessed as excessively high compared to the benefits. Moreover, the company fears the risk of cannibalizing its mainstream business of high quality and high value products by selling refurbished equipment at a lower price.

6. Conclusion

The results in the findings suggest that companies in the PCs industry can take an active approach towards the reverse supply chain without negatively affecting their performance. Although the data gathered and analyzed are not sufficient for clearly stating whether an integration strategy is more profitable compared to an outsourcing one, it is evident that both HP and Dell's supply chains are successful. Moreover, Dell besides succeeding in terms of profitability has adopted an integration approach towards reverse supply chain which provides higher social and environmental responsibility compared to HP. In fact, as highlighted by the Recycling Report Card compiled by the Electronics Take Back Coalition (Electronics Take Back Coalition, 2010), which assesses the impact on the environmental and social responsibility derived by the take back programs implemented by EEE producers, Dell has achieved a B grade in 2010 compared to a C- of HP. In addition, Dell has managed to achieve the highest grade of the entire computer industry, ahead of Asus (B-) and Apple (C+). Therefore, outsourcing the reverse supply chain activities is not always the best solution for firms in the PCs industry. The Dell case has in fact demonstrated that it is possible to succeed in the PCs industry by integrating forward supply chain activities with activities in the reverse supply chain that add value to the company, like those related to the screening, refurbishment and reselling of used products, while outsourcing activities related to the collection, transportation and recycle of products.

6.1. Review of the findings

The success of Dell can also be explained by an active embracement of reverse supply chain activities. The company has in fact adopted an active approach towards them, viewing reverse supply chain more as an opportunity for growing rather than a threat. This has resulted in the integration of activities of the forward and reverse supply chains by simultaneously increasing the synergies and reducing the conflicts between the two businesses, as suggested by Markides (2008).

A first initiative in this direction has been to introduce screening activities at the initial stages of the return process for both professional and domestic returns. This assures high cost savings by separating at the beginning of the process the non-valuable returns from the returns for refurbishment. Moreover, the integration of the screening activities with the forward supply chain provides higher transparency, which results in higher trust by professional and domestic clients for returning their used equipment.

Furthermore, the implementation of design for recycle initiatives in the forward supply chain has facilitated the disassembly of returned products both for refurbishment and for recycle, thus reducing the costs and the time associated to their treatment.

In addition, the collaboration of Dell with charity organizations, like Goodwill International and NCF, has allowed the company to augment its collection points in US and Canada which has resulted both in a reduction of the costs associated to the return and the recycle of EOL products and in an improvement of Dell's corporate image.
Finally Dell has managed to open a secondary market for its refurbished products without cannibalizing its mainstream business, indeed it has allowed Dell to enter in the lower-price computer segment representing a serious threat to low-cost PC producers. The success of Dell Outlet is also assignable to the innovative advertisement campaign implemented by Dell, which has utilized social networks like Twitter for directly interacting with customers.

Besides the number of initiatives adopted by Dell for improving its reverse supply chain activities, there are still some opportunities for improvement. As an example, the company is not managing the assembly and disassembly activities in the same locations, as recommended by Brennan et al. (1994). This reduces the opportunities for sharing resources and assets between the two chains and results in an increase of costs related to the ownership of fixed-assets and to the impossibility of quickly reutilizing in the forward chain components from the used equipment.
In addition to this, Dell pays low attention to the activities related to the recycle of products. As a matter of fact there is no interaction between Dell and municipal collection centers. As a consequence, municipalities do not screen Dell products and moreover they do not support the company in awareness campaigns for sensitizing customers. Moreover, Dell has outsourced the collection of waste to external partners and this represents an increase in costs compared to other producers.

On the other hand, HP has cofounded ERP with other EEE producers and the company has benefited of a reduction of the costs related to the collection of e-waste. Moreover, HP can better cooperate with the collective system in order to implement processes that ease the collection of WEEE for producers. HP however has not implemented screening gates for recovering products for refurbishment. HP has in fact not created a secondary market for refurbished products, since all the EOL equipment is sent to recycle. In addition, the company does not cooperate with retailers and municipal collection centers for improving the handling of returned items. Notwithstanding this, HP has adopted design for recycle policies for easing the recycle of its products.

6.2. Implications for practice

The study has attempted to show companies in the computer industry that it is possible to gain benefits from an active handling of reverse supply chain activities. It is however important that companies take a positive and active attitude towards them by carefully evaluating those activities that can be integrated with the current business and those that cannot be handled by the organization.

As emphasized by Gilbert & Bower (2002), an integrator can be employed for facilitating the integration between the two businesses. This person is responsible for convincing employees in the mainstream business of the importance of handling reverse supply chain activities, not only for the benefit of the company but also for the benefit of the society. Moreover, the integrator needs to persuade employees to adopt an integrated thinking when taking decisions for the supply chain. The supply chain needs in fact to be considered as a closed–loop chain constituted by the integration of the forward and the reverse supply chain. Therefore decisions for the forward business need always to be assessed based on their impact on the reverse supply chain activities, and vice versa.

Moreover, in order to effectively manage reverse supply chain activities, returns need to be viewed as a value stream within the organization and not as a waste stream. As a result, initiatives need to be implemented for speeding up the reverse flow of used equipment since the value of returned products and their components quickly decreases.

A first initiative is to increase the customers' awareness towards reverse supply chain activities in order to incentivize the return of used products. A suggestion is to adopt innovative solution, like Dell did, by sensitizing customers through the social networks, like statements on Twitter or pages/events on Facebook, for rendering the message viral.

Moreover, effective screening activities at the initial stage of the return process need to be performed in order to select the right reverse channel for each product. This would let the company both reduce the time and the costs involved with the reverse supply chain activities. A low-cost screening gate can be represented by a phone-assistant who can help customers identifying the best solution, however customers need to be aware of this.

Once products have been screened, they should be easily disassembled in order to facilitate the reutilization of components on other products, thanks to the modularity of components, or to ease the separation of materials during the recycle process.

Furthermore, producers need to develop secondary markets for remarketing the refurbished products. As highlighted in Dell section, secondary market can allow companies to enter in lower-price segments representing threats for low-cost competitors. Producers need however to assure a sufficient quality of the products for not undermining their brand image in the higher-price segment.

Besides the implementation of internal initiatives for improving the handling of returned products, companies need also to augment the coordination between all the players involved with the reverse supply chain. In this sense, one of the main hurdles is represented by the collection of waste by municipalities. As a matter of fact, by law municipal collection centers do not have the right to screen products, but they can only act as collection points for domestic users. Municipal collection centers however represent one of the first gates for the reverse stream of domestic EOL products and therefore a screening of the returns at this point would assure a higher recovery rate of products for

refurbishment instead of assessing all the returns as waste. Moreover, thanks to the closeness of municipal collection centers to citizens, municipalities can support producers in providing higher visibility to the awareness campaigns in order to sensitize consumers for returning their used products. Producers should therefore dialogue with public entities in order to give more responsibilities to municipal collection centers for the benefit of the entire supply chain.
Overall, producers need to actively cooperate with each player involved with the reverse supply chain in order to improve the sharing of information along the channel with the goal to implement a lean reverse supply chain. Producers should in fact adopt a network strategy in order to commit with every player in the reverse supply chain for the achievement of a common goal for the network.

6.3. Contribution to knowledge and limitations of the study

The research study can be considered as a first attempt to reconstruct the configuration of the reverse supply chain of companies in the PCs industry and the strategies adopted by the producers for cooperating with the players involved with the chain.
Moreover, in this research the reverse supply chain has been considered as a value stream and not as a series of costly activities for firms. This way, the study has attempted to show researchers that it is possible to benefit from reverse supply chain activities if they are effectively managed. The benefit has not to be considered only as a reduction of costs but also as higher profitability due to the selling of refurbished products and due to an improvement of the corporate image of the company.
In addition to this, the thesis has provided evidence that there are possibilities for managing the reverse supply chain activities together with the mainstream business although the majority of researches so far conducted in the logistics literature has supported a pure outsourcing strategy.

The research however does not have the presumption of presenting a universal model for managing the dual business model of forward and reverse supply chain in the PCs industry. Besides being a dual case study, and therefore being strongly company-related; it has been difficult to gather information related to the performance of the two companies in relation to the reverse supply chain activities. This has been due to the fact that both Dell and HP consider these activities as marginal compared to the mainstream business and therefore they are not sufficiently controlled and evaluated. Moreover, it has not been possible to interview Dell, so while in the case of HP primary data have been utilized for describing the reverse supply chain, secondary data have been used for Dell.
In addition to this, due to the absence of effective screening gates, it is almost impossible to extrapolate information related to the type of returns, for example the number of EOL equipment returned compared to commercial returns etc. Moreover, the KPIs analyzed are in the major of the cases related to the mainstream business, since few data regarding the reverse supply chain activities

have been published or provided. Therefore, it has been impossible to find reverse supply chain data from the information of the overall company, so the KPIs have been assumed to portray the results of the management of the dual business models, although for the majority they only refer to the forward supply chain, due to the marginal importance given to reverse supply chain activities.
It is however possible to state that while reverse logistics activities only represent a source of cost for HP, in the case of Dell they also represent a source of revenue. Notwithstanding this, it is impossible to determine whether the reverse supply chain of EOL PCs alone represents a profitable business or not for Dell.

6.4. Recommendations for further research

The current scenario in the PCs industry presents several lacks in terms of the management of reverse supply chain activities. This is also due to a lack of research in this field.

Firstly, additional research is needed for defining appropriate performance indicators for measuring the efficiency of reverse supply chain management initiatives. These measures need not only to reflect the performance of PCs producers but also of the different players in the reverse channel. Only this way the efficiency of the reverse supply chain can be assessed and improvements can be handled for maximizing it. Organizations and public entities need however to be willing to cooperate for rendering information related to the return flows accessible to every player in the channel.
Moreover, proper performance indicators need to be identified for assessing the impact of reverse supply chain activities on the mainstream business. For example, the reduction of costs associated to components reutilization, to the share of assets and resources, etc. This way, EEE producers would be facilitated in thinking at a closed loop supply chain compared to two separated chains, where decisions related to a chain need to be considered also depending on their impact on the other supply chain.
In addition to the need for new performance measures, reverse logistics literature still misses a framework which organizations could utilize for deciding how to manage the dual business model. The framework suggested by Markides (2008) could for example be adapted to the PCs industry in order to assess which strategy would be the most suitable for managing the forward and reverse supply chain businesses. A research of the conflicts and of the synergies between the forward and reverse supply chains would need to be handled by interviewing a number of managers involved with reverse supply chain activities in the PCs industry.

Appendix

Appendix 1: List of references

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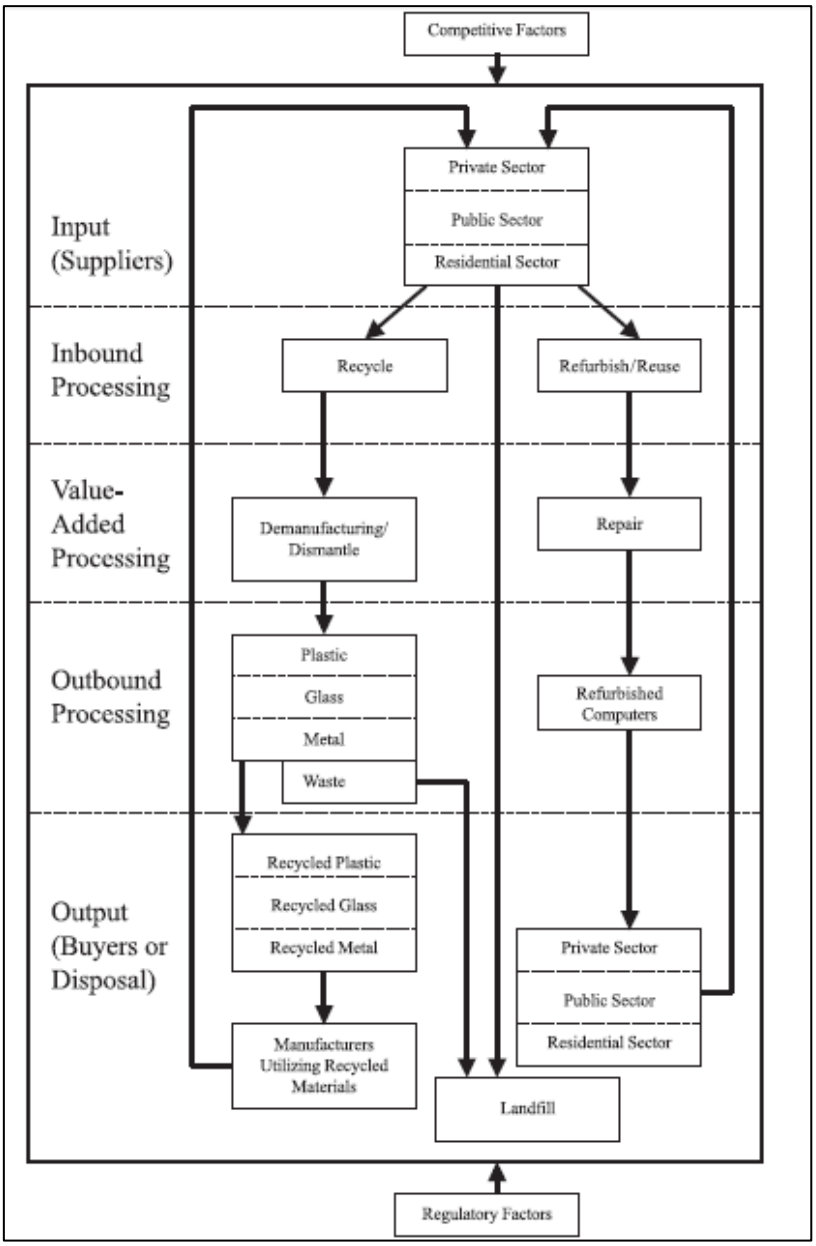
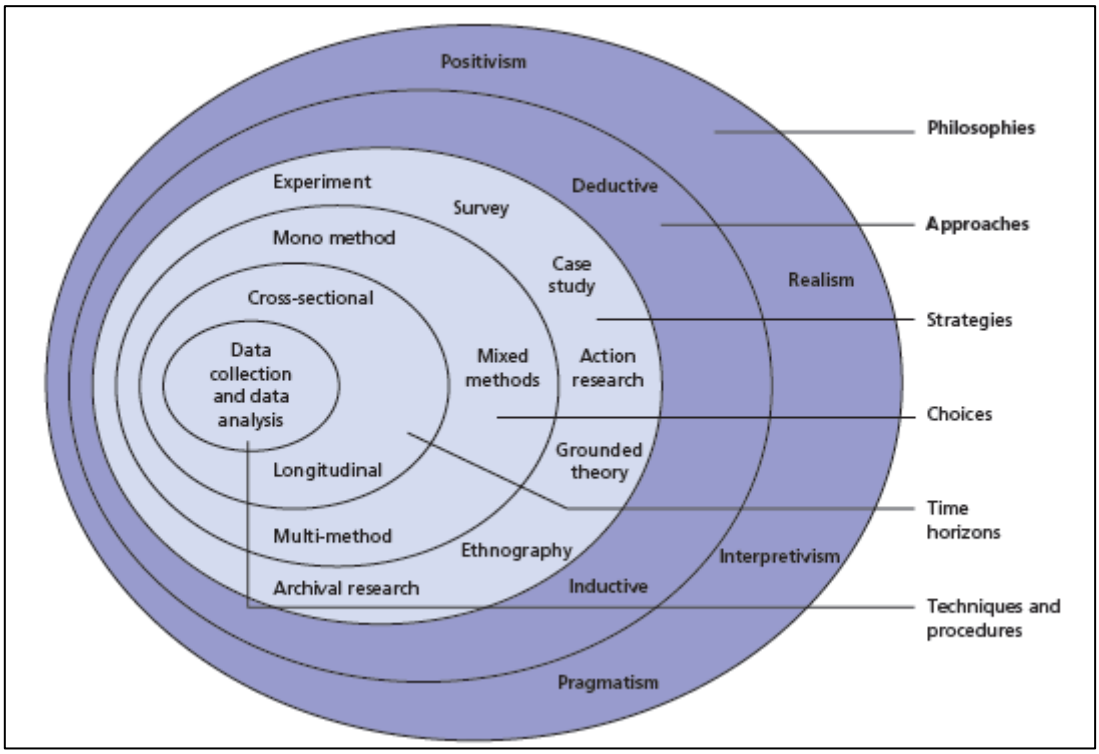
Appendix 2: Proposed model of reverse logistics for EOL PCs



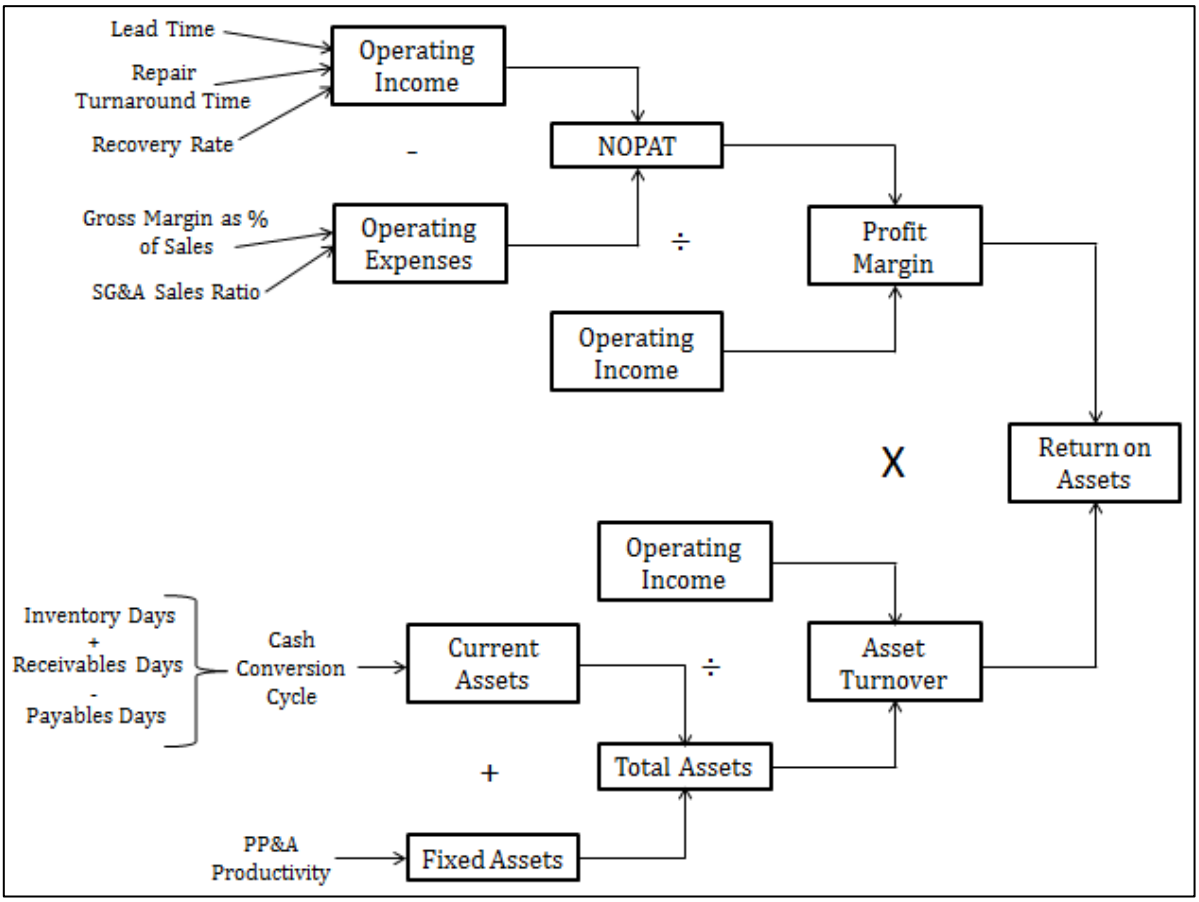
Source: Knemeyer, Ponzurick and Logar (2002)

Appendix 3: The Research Onion Framework



Source: Saunders, Thornhill, & Lewis (2009)

Appendix 4: The DuPont Formula



Source: Adapted from Reeve (2002)

Appendix 5: Dell Inc. Financials

Reclassified Income Statement

	February 3, 2012	January 28, 2011	January 29, 2010
	(Values in millions except percentages)		
Net Revenue:			
Products	49,906	50,002	43,697
Services	12,165	11,492	9,205
Total net revenue	62,071	61,494	52,902
Cost and expenses:			
Cost of products	39,689	42,068	37,534
Cost of services	8,571	8,030	6,107
Research, development and engineering	856	661	624
Selling, general and administrative	8,524	7,302	6,465
Total operating expenses	57,640	58,061	50,730
EBIT	4,431	3,433	2,172
Tax rate	17,6%	21,3%	29,2%
NOPAT	3,651	2,700	1,538

Consolidated Balance Sheet

Assets

	February 3, 2012	January 28, 2011	January 29, 2010	January 30, 2009
		(Values in millions)		
Current assets:				
Cash and cash equivalents	13,852	13,913	10,635	8,352
Short-term investment	966	452	373	740
Accounts receivables	6,476	6,493	5,837	4,731
Financing receivables	3,327	3,643	2,706	1,712
Inventory	1,404	1,301	1,051	867
Other current assets	3,423	3,219	3,643	3,749
Total current assets	**29,448**	**29,021**	**24,245**	**20,151**
Property, plant and equipment	2,124	1,953	2,181	2,277
Investments	3,404	704	781	454
Long-term financing receivables and other assets	1,372	799	332	500
Goodwill	5,838	4,365	4,074	1,737
Purchased intangible assets	1,857	1,495	1,694	724
Other non-current assets	490	262	345	657
Total Assets	**44,533**	**38,599**	**33,652**	**26,500**

Liabilities

	February 3, 2012	January 28, 2011	January 29, 2010	January 30, 2009
		(Values in millions)		
Current liabilities:				
Short-term debt	2,867	851	663	113
Accounts payable	11,656	11,293	11,373	8,309
Accrued and other	3,934	4,181	3,884	3,736
Short-term deferred services revenue	3,544	3,158	3,040	2,701
Total current liabilities	22,001	19,483	18,960	14,859
Long-term debt	6,387	5,146	3,417	1,898
Long-term deferred services revenue	3,836	3,518	3,029	3,000
Other non-current liabilities	3,392	2,686	2,605	2,472
Total liabilities	**35,616**	**30,833**	**28,011**	**22,229**
Stockholders' equity	**8,917**	**7,766**	**5,642**	**4,271**
Total liabilities and stockholders' equity	**44,533**	**38,599**	**33,652**	**26,500**

Financial Ratios

	2012	2011	2010
Net Revenue	62,071	61,494	52,902
Average Total Assets	41,566	36,126	30,076
Asset Turnover	**1.49**	**1.7**	**1.76**

	2012	2011	2010
COGS	48.260	50.098	43.641
Revenue	62.071	61.494	52.902
Gross Margin as % of Sales	**22.25%**	**18.53%**	**17.51%**

	2012	2011	2010
NOPAT	3,651	2,700	1,538
Net Revenue	62,071	61,494	52,902
Profit Margin	**5.88%**	**4.39%**	**2.91%**

	2012	2011	2010
SG&A	8,524	7,302	6,465
Revenue	62,071	61,494	52,902
SG&A sales ratio	**13.73%**	**11.87%**	**12.22%**

	2012	2011	2010
Asset Turnover	1.49	1.70	1.76
Profit Margin	5.88%	4.39%	2.91%
ROA	**8.78%**	**7.47%**	**5.11%**

	2012	2011	2010
Net Revenue	62,071	61,494	52,902
PPE	2,039	2,067	2,229
Fixed Asset Efficiency	**30.45**	**29.75**	**23.73**

	2012	2011	2010
Cost of Sales	48,260	50,098	43,641
Inventory	1,353	1,176	959
Inventory Efficiency	**35.68**	**42.60**	**45.51**
Inventory Days	**10.23**	**8.57**	**8.02**

	2012	2011	2010
Revenue	62,071	61,494	52,902
Accounts Receivables	6,485	6,165	5,284
Accounts Receivables Days	**38.13**	**36.59**	**36.46**

	2012	2011	2010
Cost of Sales	48,260	50,098	43,641
Accounts Payables	11,475	11,333	9,841
Accounts Payables Days	**86.78**	**82.57**	**82.31**

	2012	2011	2010
Cash Conversion Cycle	**-38.42**	**-37.41**	**-37.83**

Appendix 6: Hewlett-Packard Financials

Reclassified Income Statement

	October 31, 2011	October 31, 2010	October 31, 2009
	(Values in millions except percentages)		
Net Revenue:			
Products	84,757	84,799	74,051
Services	42,039	40,816	40,124
Financing income	449	418	377
Total net revenue	**127,245**	**126,033**	**114,552**
Cost and expenses:			
Cost of products	65,167	65,064	56,503
Cost of services	32,056	30,590	30,660
Financing interest	306	302	326
Research and development	3,254	2,959	2,819
Selling, general and administrative	13,466	12,718	11,648
Amortization of purchased intangible assets	1,607	1,484	1,578
Impairment of goodwill and purchased intangible assets	885	0	0
Restructuring charges	645	1,144	640
Acquisition-related charges	182	293	242
Total operating expenses	**117,568**	**114,554**	**104,416**
EBIT	9,677	11,479	10,136
Tax rate	21.2%	20.2%	18.6%
NOPAT	**7,625.476**	**9,160.242**	**8,250.704**

Consolidated Balance Sheet

Assets

	October 31, 2011	October 31, 2010	October 31, 2009	October 31, 2008
		(Values in millions)		
Current assets:				
Cash and cash equivalents	8,043	10,929	13,279	10,153
Short-term investments	0	0	55	93
Accounts receivables	18,224	18,481	16,537	16,928
Financing receivables	3,162	2,986	2,675	2,314
Inventory	7,490	6,466	6,128	7,879
Other current assets	14,102	15,322	13,865	14,361
Total current assets	**51,021**	**54,184**	**52,539**	**51,728**
Property, plant and equipment	12,292	11,763	11,262	10,838
Long-term financing receivables and other assets	10,755	12,225	11,289	10,468
Goodwill	44,551	38,483	33,109	32,335
Purchased intangible assets	10,898	7,848	6,600	7,962
Total Assets	**129,517**	**124,503**	**114,799**	**113,331**

Liabilities

	October 31, 2011	October 31, 2010	October 31, 2009	October 31, 2008
		(Values in millions)		
Current liabilities:				
Notes payable and short-term borrowings	8,083	7,046	1,850	10,176
Accounts payable	14,750	14,365	14,809	14,917
Employee compensation and benefits	3,999	4,256	4,071	4,159
Taxes on earnings	1,048	802	910	869
Deferred revenue	7,449	6,727	6,182	6,287
Accrued restructuring	654	911	1,109	1,099
Other current liabilities	14,459	15,296	14,072	15,432
Total current liabilities	**50,442**	**49,403**	**43,003**	**52,939**
Long-term debt	22,551	15,258	13,980	7,676
Other liabilities	17,520	19,061	17,299	13,774
Stockholders' equity	**39,004**	**40,781**	**40,517**	**38,942**
Total liabilities and stockholders' equity	**129,517**	**124,503**	**114,799**	**113,331**

Financial Ratios

	2011	2010	2009
Net Revenue	127,245	126,033	114,552
Average Total Assets	127,010	119,651	114,065
Asset Turnover	**1.00**	**1.05**	**1.00**

	2011	2010	2009
COGS	97,223	95,654	87,163
Revenue	127,245	126,033	114,552
Gross Margin as % of Sales	**23.60%**	**24.10%**	**23.91%**

	2011	2010	2009
NOPAT	7,625	9,160	8,251
Net Revenue	127,245	126,033	114,552
Profit Margin	**5.99%**	**7.27%**	**7.20%**

	2011	2010	2009
SG&A	13,466	12,718	11,648
Revenue	127,245	126,033	114,552
SG&A sales ratio	**10.58%**	**10.09%**	**10.17%**

	2011	2010	2009
Asset Turnover	1.00	1.05	1.00
Profit Margin	5.99%	7.27%	7.20%
ROA	**6.00%**	**7.66%**	**7.23%**

	2011	2010	2009
Cost of Sales	97,223	95,654	87163
Inventory	6,978	6,297	7003,5
Inventory Efficiency	**13.93**	**15.19**	**12.45**

	2011	2010	2009
Cost of Sales	97,223	95,654	87,163
Inventory	6,978	6,297	7,004
Inventory Efficiency	**13.93**	**15.19**	**12.45**
Inventory Days	**26.20**	**24.03**	**29.33**

	2011	2010	2009
Revenue	127,245	126,033	114,552
Accounts Receivables	18,353	17,509	16,733
Accounts Receivables Days	**52.64**	**50.71**	**53.31**

	2011	2010	2009
Cost of Sales	97,223	95,654	87,163
Accounts Payables	14,558	14,587	14,863
Accounts Payables Days	**54.65**	**55.66**	**62.24**

	2011	2010	2009
Cash Conversion Cycle	**24.19**	**19.07**	**20.40**

Appendix 7: Transcription of the interview with Maurizio De Beni - Ecology Alderman of Affi

Date: 2/10/2012

Location: Affi Town Hall – Affi (VR-Italy)

F: Francesco Cottini (Interviewer)

M: Maurizio De Beni (Interviewee)

F: Which type of WEEE do you collect, only domestic or also professional WEEE?

M: We are registered with the "Centro di Coordinamento RAEE" (CdCRAEE) which regulates the management of WEEE. The Italian law n. 151 of 25th of July 2005 prohibits municipal collection centers to collect professional WEEE. The only way for being allowed to collect it is to sign an agreement with retailers or distributors and, as a result, an award is recognized to the municipal collection center. However, since we are a small town and we have just opened the collection center, now we only collect domestic WEEE. This is a politic decision which does not depend on the technical office, moreover we have preferred not to sign the covenant also because the agreement with ANCI (Associazione Nazionale Comuni Italiani) has changed and as a consequence, from the 1st of October 2012, if a collection center signs this agreement it is obliged to accept WEEE not only from retailers which reside in the town of Affi but also from retailers outside the town. Since we have just opened and we are facing some difficulties, we are now testing how the entire process works in terms of spaces, dimensions etc., so for the moment the administration has preferred to refuse signing the agreement. However, by signing the covenant we would benefit of the for-free waste recycle and also of awards and incentives for the collection of the waste. Notwithstanding this, the town and the collection center are small so we need some time to understand how the process works and then we might think about it.

F: But does every town/village have its own WEEE collection center? How was the Directive put into practice in Italy?

M: Yes of course. Every town/village has to be registered with the "Centro di Coordinamento RAEE" and organize a collection center for the collection of WEEE. By being registered with the CdCRAEE, towns do not pay for managing the collection of WEEE but they have to accept any domestic WEEE returned by consumers. The Italian law has been enacted following the European Directive 2002/95/CE and the European Directive 2003/98/CE related to the reduction of hazardous substances. ANCI, which represents all the Italian townships, and CdCRAEE, which is a public entity financed by the EEE producers, cooperated for regulating the collection of WEEE in Italy. Producers

were against the European Directive, since they wanted the cost of collecting and recycling the waste to be entirely paid by municipalities. However, in other countries such as Belgium, the Netherlands, etc., producers were already paying for the disposal of e-waste. Now, companies which produce and sell electronic and electric equipment (EEE) have to pay the CdCRAEE for the activities related with the disposal and recycle of the waste. The CdCRAEE has invited tenders for the collection of the WEEE in the different geographical areas in Italy, so that different companies are responsible for recycling the waste in the different areas. As a result, municipal collection center only have to access the CdCRAEE website and state which group of WEEE needs to be collected for recycling. Within seven days, a recycling company has to come to the collection center, empty the baskets containing the WEEE and transport the waste to the treatment facility assigned by the CdCRAEE. Collection centers do not have to pay anything for the service. Before the Directive took place townships had to pay around 38€ per ton of e-waste.

F: How do you group the waste?

M: The CdCRAEE assigns specific recycling company to the different municipalities depending on their dimensions and on their proximity to the treatment facility. Moreover, it also provides the municipal collection center with a determined amount of baskets for the different waste groups, depending on the dimensions of the town. The dimension of the baskets is one meter per one meter, and the worker at the collection center places the waste in good order, without launching it, so that the basket can be filled in an efficient way. This however regards only the R3 (monitors) and R4 groups. The R2 (stoves and washing equipment) and R1 (refrigerators) groups are instead laid on the ground.

F: How are computers separated from the other WEEE at the collection center?

M: Computers are included in two WEEE categories, in fact monitors have to be included in the third WEEE category (R3), while PCs are separated from them and grouped within the fourth WEEE category (R4).

F: But do you screen the products in terms of brand?

M: No. The only screening is in term of quality of products. The waste needs to be in one-piece; we cannot accept parts of e-waste. Being us a collection center, we cannot handle activities different to the collection of waste. In order to enter the collection center, individuals need to swipe the health-card where all the data of the individual are visible. Through this method, it is possible to monitor the waste delivered by individuals and register it, in order to control the integrity of the e-waste delivered.

F: But if for example I deliver a brand new product to the collection center, do you accept it?

M: The worker at the collection center is not allowed to screen products. Everything received is recycled.

F: What about retailers, how do they organize the collection of WEEE?

M: Retailers need to provide covered area for the collection of WEEE and they can keep it there until an authorized companies come to transport it from the retailer to a treatment facility. In order to transport WEEE companies need in fact a special authorization. However, waste producers (individual consumers) do not need to be authorized to transport e-waste from their site until the collection center.

F: When the baskets are full, what do you do?

M: I access the CdCRAEE website, this happens almost every two months, and I state the number of baskets that need to be emptied or the number of refrigerators that I have. However, there is always a minimum number required for asking for the service, otherwise municipalities need to pay for it.

F: Are there different companies responsible for collecting the WEEE from the collection center to the treatment facility for the different WEEE groups?

M: The CdCRAEE is the one deciding which company is responsible for transporting the WEEE from the collection center to the treatment facility. It is the entity inviting companies to the tender, and based on that the allocation of the WEEE collection is assigned. If each municipality had to decide with which company to handle the recycle process, the negotiation power would be lower for municipalities, and therefore the cost paid by citizens would be much higher. On the other hand, by organizing a national competitive tender, the allocation of the collection and recycle process is more efficient.

F: So your activity concerns only the collection of waste, no screening or disassembly?

M: It is forbidden to handle them. As being collection centers, it is absolutely forbidden to handle disassembly activities. We can only control the waste and collect it.

F: What happens once a company has collected the waste from the collection center?

M: The idea was to adopt a RFID technique (SISTRI) for tracing the hazardous waste. Instead of using a paper form for tracing it, which identifies the sender, the receiver and the transporter, the system would have used a GPS technique for tracing the waste during the entire recycle process. However, the system was never set into motion since there were too many software problems. Moreover, when some entities investigated who was the provider of the service, the government stated that it was a military secret. As a result, the SISTRI technique was removed, despite some companies had paid

thousands of money for adopting the technique. So the paper form is still used for identifying the flow of e-waste. As you can see from the form, there are four copies. The third copy is given to the producer of waste, e.g. the collection center, and as you can see the weight of the waste is not written, since the collection center is not obliged to weight it. The form contains the name and the address of the receiver, the name of the transporter, the type and the characteristics of the waste transported, the number of baskets collected, the weight of the waste to be verified at destination and the signature of the producer (collection center) and of the transporter. The receiver can be either a treatment facility or a stocking facility, from where the waste is then sent to a treatment facility. The receiver has to send the fourth copy of the form back to the collection center within 40 days. On the fourth copy also the weight of the waste is reported. Until the fourth copy is not received by the municipality, the township is responsible for the waste. As a consequence, the municipality needs to communicate to the provincial office that the waste has not reached the destination.

F: Do you know if any sort of screening is handled at the treatment facilities?

M: It might happen that the waste is sorted based on the brand and then returned to the producer, but I am not sure. However, companies might also receive their products from retailers. In fact the "one against one" law states that for every brand new product purchased, retailers have to accept the old equipment. So it might be that products are screened by brand at the retailer's site.

F: Is the recycle process entirely paid by producers?

M: Before the Directive, municipalities had to pay for the collection of the WEEE. Now this is partially done by the consumers, by paying a recycle tax when buying the new products, and by producers for the major part. Municipalities can also decide to be part of a consortium instead of self-managing the collection of WEEE. A consortium is a private entity which offers public services to townships. In the case of the WEEE collection, they manage all the collection activities on behalf of the municipalities, which pay a fee for the service. In Verona, the consortium comprehends around 14-15 towns.

Appendix 8: Transcription of the interview with Martina Scoponi – STENA Technoworld

Date: 16/10/2012

Location: STENA Technoworld – Angiari (VR-Italy)

F: Francesco Cottini (Interviewer)

M: Martina Scoponi – Technical Support Engineer at STENA Technoworld (Interviewee)

F: *Could you please describe the WEEE market in Italy based on the European Directive?*

M: Each European country has acknowledged the European directive. In Italy the WEEE market is composed of consortiums of producers, which are grouped depending on their location in the country, on their dimensions, etc.., in order to collect the disposed goods. The consortiums are our clients, and some of them are: Remedia, for electronics, Esageraee, Ecodom, Raeecycle, ERP. The consortiums manage the collection of the WEEE and their goal is to assure that the WEEE is properly recycled. Each consortium has a specific number of collection points and they organize annual or biannual competitive tenders (depending on the WEEE category) for the treatment facilities in order to allocate each collection point based the efficiency, the quality and the recycle rate. When the collection center has reached the maximum capacity for a specific WEEE category it contacts the consortium which will send the request to a specific treatment facility. STENA, by contract, has to collect the waste within 48 hours from the request and afterwards the consortium pays the treatment facility for the treatment and the logistics activities. However, STENA pays for receiving non-hazardous material. Specifically, STENA is paid for treating the refrigerators, the neon lights and the televisions; while it pays for receiving the washing machines, dishwashers, and all the electronics, so also the PCs. The 80% of the incoming material arrives through consortiums. STENA does also deal with the activities related to the transportation of WEEE from the collection center to the treatment facilities. The freight operators must be authorized to transport WEEE, since this contains hazardous material.

F: *How do the consortiums manage the WEEE flow from retailers?*

M: In Italy the "one against one" regulation has come into effect. This means that for example when you buy a new television, you have to deliver the old one back to the retail store. Retail stores are obliged by law to recover the old equipment from customers and to properly dispose of it. As a matter of fact, every time you buy a new Electrical or Electronic Equipment (EEE) there is always a fee to be paid which is called disposal tax. So the consortiums have the objective to control all the players involved with the recovery and recycle or disposal of the WEEE. In Italy for example, the consortiums control the quality processes of the players through annual audits.

F: *So what are the possible options for a domestic customer when disposing of a WEEE?*

M: Either you bring it to a retail store, which will properly handle the return process, or to a municipal collection center. From there, depending on the treatment facility assigned to a determined collection center, the WEEE will be transported to a treatment facility by authorized freight operators together with a form composed of four copies. One is addressed to the treatment facility, one to the freight operator, and one needs to be returned to the producer of WEEE, which is either the collection center or the retailer. So the producer retains two copies: the first one emitted by itself and the last one which confirms the arrival of the waste at the treatment facility. Here the WEEE is weighted in order to understand the amount of the incoming material.

F: *Do you receive WEEE only from collection centers or also from other entities?*

M: We divide our market into B2B (organizations, like private companies and banks, which are particularly sensitive to the deletion of private data and information and want to be sure that the WEEE arrives to the treatment facility) and B2C (which represents domestic WEEE from collection centers).

F: *Which types of WEEE do you receive, only EOL products or also equipment that could be refurbished?*

M: We do not screen products and do not reutilize products, we only treat waste. Therefore, we are only authorized to treat the waste and we do this through five facilities. Here in Angiari, where we have two facilities, we are authorized to treat televisions and monitors, while in the other facilities we are authorized to treat all the electronics and the refrigerators. The regulations in terms of waste treatment are highly severe so for example we are not authorized to treat neon lights. We can receive them but then we have to send them to a facility authorized to treat it. Some material can only be received for stocking purpose and then we have to deliver it to the proper facility for treating or disposing. All the incoming material is registered through the forms, in addition we have a software for the management of the waste, everything is weighted and codified, and what enters has also to exit. We cannot recycle the material with the intention of reusing it.

F: *Could you please describe the recycling process for the EOL PCs?*

M: PCs are received either from B2B customers or from the collection centers. Once arrived at the treatment facility they are first weighted, and then they are unloaded on a conveyor belt where they reach the disassembly station. Here first the case is removed, then the disks and the cards are taken away since they cannot be recycled. The cables and the vans are separated in specific boxes as well as the plastics and the iron components. The only material that cannot be recycled is the quicksilver.

F: *So does it mean that you screen the components that can be reutilized?*

M: No, we recycle everything; we do not screen any product. We do not have any contact with the producers of EEE for components reutilization, since we are not authorized to resell for the reutilization of components. At the end we only sell fractions of the good.

F: *What happens once the materials have been recycled?*

M: The 95% of the income waste exits from the treatment facility as a fraction. So we sell this fractions through our channels.

F: *Are there different strategies for the recovery of WEEE in Europe?*

M: European countries are aligned in terms of regulation, even though the Italian law is a bit more severe compared to the other countries. European directives should act as "guillotine laws" for the countries, however different regions and cities approve exception for the application of the directive. In Sweden for example the WEEE management had been regulated before the European Directive was approved and there is only one consortium that manages the collection of WEEE. As a result, the treatment facilities receive the material at zero cost. They do not gain from incoming products but they have only one client in terms of consortium. Then they also receive waste from private clients.

F: *If for example I decide to dispose of a laptop bought one week ago by bringing it to a collection center, is there a screening gate or will the product be recycled?*

M: None both at the collection center and at the treatment facility is authorized to screen the product.

F: *Do you have some information related to the ERP?*

M: ERP is one of our clients. It delivers to us every WEEE category (refrigerators, televisions, electronics, etc.)

Appendix 9: Transcription of the interview with ERP Italy and HP Italy

Date: 14/11/2012

Place: HP Italy – Cernusco Sul Naviglio (MI-Italy)

F: Francesco Cottini (Interviewer)

H: HP (Interviewee)

E: ERP (Interviewee)

F: By looking at the two pictures, which have been depicted through information gathered through secondary research and which represent the PCs' forward and reverse supply chain of HP, could you confirm that this is the actual configuration of the two chains?

H: Regarding the forward supply chain, the picture correctly depicts the current configuration of the HP PCs' supply chain. The direct channel is utilized above all for large professional customers, while consumers' clients are served through an indirect channel. This channel is constituted of few distributors (from 5 to 10) and thousands of retailers.

F: Which activities in the forward supply chain does HP handle?

H: R&D, marketing, and some phases of the production. The majority of the production processes, like for example the assembly, are however outsourced to external partners. Despite this, all the products are thought, designed, created and marketed directly by HP.

F: Regarding the reverse supply chain I am mainly focusing on the EOL products, and in the picture I have represented the reverse supply chain depending on the type of return, distinguishing between professional and domestic returns. Does this configuration resemble the reality?

H: As you pointed out, the first important distinction to be made is to separate the EOL products from the commercial and leasing returns, demos, trade-in and production surplus. Then the configuration depends on whether the returns are from professional customers or domestic ones. Asset recovery is a financial service offered to companies who wish to receive help and solutions in finding the best way to proceed. For more details we have a dedicated page on our website: http://www8.hp.com/us/en/hp-financial-services/solutions/asset-recovery.html

F: But let's assume that a professional client decides to return a computer after 2 years from its purchase, is it considered for refurbishment or is it sent for recycle?

H: It might happen that it is considered for refurbishment but when this happens the product is not considered as waste regulated by the WEEE directive, which means that it is not considered as waste by HP.

E: It depends on how this product is defined: if it is considered as waste then the return is regulated by the WEEE directive, while if it is not considered as waste then the process is different. The client decides if a product has become waste for him.

H: The screening of the product is performed by the client, and it is important to understand whether the product can be reutilized or not.

F: So how is the process when the product is deemed for reutilization?

H: In this case, the product follows a complete different channel compared to the waste channel. When companies want to give back PCs which still have to reach their end-of-life, they can adopt the trade-in option. In this case, the PCs are rebought by HP partners, so companies can get back some value from their used products. However, these flows are absolutely marginal to the HP main business; the majority of the products returned by professional clients are in fact at their end-of-life stage and therefore they are sent for recycle.

F: This means that already at the client's site there is a screening of the returns, is this true?

H: The screening is handled by the customer itself, not by HP. Let's say that I am a bank and I want to change my PCs, if I deem that my computers still have a value, I can contact HP and ask for a trade-in value; in this case HP can propose an offer for substituting the used PCs with new ones and offer some value for the old PCs. Afterwards, the computers are sent through an assessment process in order to understand if there is a value that can be recovered. This is however done by the client, by deciding whether to recycle or to trade-in the product. However, the majority of products collected is represented by EOL equipment which is too costly for companies to keep using them and therefore are sent for recycling. It is not part of HP's business strategy to refurbish EOL products, and to provide a new warranty for it, so usually the EOLs are not refurbished. As a consequence the EOL PCs enter in the recycle channel.

F: But do the Asset Recovery Service Teams (ARST) deal with activities in the forward supply chain or do they only perform activities in the reverse one?

H: I do not know them, so I cannot answer. However I doubt that they are connected with the distribution process. With this I mean that the forward supply chain is a completely separated organization from the reverse chain, so the forward supply chain can sell new products or refurbished

products but it does not have contact with those performing the activities related to the refurbishment of the used products. The renewal of the products is analog to a factory producing a product.

F: Do you know the percentage of professional products that can be reutilized compared to those sent for recycle?

H: I do not know the percentage; however the amount of products sent for recycling is a huge number. This is however not necessarily due to the fact that they cannot be reutilized, but because the clients do not send them for reutilization. Moreover, when they are recovered from the client, they are recovered for recycling since they have already been categorized as waste.

E: Also because of the fact that professional clients are highly sensitive to private data and information recorded in the PCs and therefore they want to be sure that their equipment is properly recycled.

F: Which player is responsible for managing the logistics of the products returned for recycling? Is it ERP or other logistics companies?

H: ERP is one of the Compliance Schemes authorized to manage electronic waste and it has been chosen by HP for collecting the e-waste in the majority of the European countries. Since the European Directive has stated that each producer is responsible for the amount of electronic waste that it has produced, HP deals with it through ERP, that is a separated company to HP but which has been co-founded by HP and as a result HP is one of its shareholders.

F: But how can the individual producer responsibility be attained if there is no screening of the products assigned for recycle?

E: In fact the individual producer responsibility has not been put into effect.

H: Let's say that it has been carried out in economic terms, not in practical terms. The waste of each producer is not screened, but the cost to be paid by each company is determined based on the volume of products sold into the market.

E: The cost for each producer depends on its market share. The directive dictates that producers organize the collection of their e-waste for each country. Ideally, if the sold equipment adopted a RFID technique, it would be possible to map the path of each product; however I guess that this will not be implemented within at least the next five years. As a consequence, in order to divide the responsibility for each company for the waste produced, the market share is used as an estimate since it is assumed that companies that sell a large amount of products also have a large amount of returns to handle. Actually, this assumption is not completely true, since for companies like HP, which invest a lot for increasing the life cycle of their products and therefore sell high quality products, the average life of products might last five years rather than the product of a cheap competitor which only lasts two

years. Despite this, being impossible to find a solution to the problem, this method can be seen as a compromise for defining the responsibility for each producer.

In the case of Italy, the country is divided based on the total number of collection centers by the "Centro di Coordinamento RAEE" (CdCRAEE) and then these are allocated to the 14-15 Compliance Schemes that are present in Italy. The CdCRAEE has then created an algorithm for determining the responsibility for the Compliance Schemes when collecting the waste in the country. This assures that each Compliance Scheme puts the same effort and that every collection center in Italy is served. This results in a fair costs distribution between the Compliance Schemes. Each Compliance Scheme then handles the transportation of the e-waste from the collection center to the treatment facility.

F: As collection center do we intend only a municipal collection center or also a professional client's site?

H: No, the collection points are only municipal or authorized collection points, not in any case, professional clients' sites.

F: And what about the retailers? Do they also have specific collection points?

E: Each retailer, seen as a Producer defined by the Directive, needs to be registered with a Compliance Scheme and can/must also become a collection center serviced by one of the National Compliance Schemes. As a consequence, as with the municipal collection points, a specific Compliance Scheme is responsible for collecting the waste from the retailer.

H: A certain number of collection centers are assigned to each Compliance Scheme so that both the amount of waste to be treated and the distance between the treatment facilities and the collection centers assigned is similar for each Compliance Scheme. These considerations are taken into account by the CdCRAEE when assigning the collection centers to the Compliance Schemes in order to assure a fair distribution of responsibilities and costs. The allocation of the collection centers to the Compliance Scheme is also distributed geographically, which means that each Compliance Scheme has some collection points in each Italian region.

E: By accessing the CdCRAEE website (www.cdcraee.it) consumers can find the closest collection point to their sites and by clicking it is possible to view all the collection points in a territory and see which Compliance Scheme is responsible for the collection of a specific group of waste for each site. In fact, different Compliance Scheme can handle the collection of different e-waste categories depending on the collection center. ERP for example, has the capability to deal with every e-waste category whilst several other National Compliance Schemes handle only some of the five WEEE groups.

F: So is a treatment facility, like STENA for example, your client?

H: No, STENA is a supplier since all the material collected at a recycling center is transported by a Compliance Scheme to one/two/three suppliers which are those handling the treatment of the waste. As a consequence, the Compliance Scheme needs to pay or (rarely) to be paid (depending on the type of waste) for the treatment service. STENA for example is one of the largest waste treatment companies, and it receives waste from different Compliance Scheme. It might also happen that some Compliance Scheme have their own treatment facility, however in most of the cases the service is outsourced to external partners.

F: What about ERP? Do you have your own treatment facility?

E: Absolutely not. It would be in contradiction with our business scope.

F: Does HP, being a co-founder of ERP, have some advantages compared to other participating companies or other producers?

H: HP is a shareholder and therefore, being part of the board of directors, it can have part in the decisions for the Compliance Scheme (how to do it, where to do it, etc.). This is the advantage, although the decisions are taken together with other shareholders.

F: How is ERP viewed by HP? Is it considered like an own company or just as an external partner?

H: It is for sure an external partner; however there is a tight relationship between the two, but bear in mind that the activities related to the management of the e-waste are only followed by very few dedicated experts.

E: HP however started to recycle in 1987, a lot before experts started to think about the WEEE Directive. This means that HP was already dealing with the recycle process, then when the Directive was approved HP became an important player in the industry and as a result it co-founded ERP for several reasons: HP was thinking that this was in favor of competition, by facing the risk of a monopoly in the e-waste management, and as a consequence it would have reduced the costs related to the financing of the reverse logistics while making a good service to environment.

H: As a matter of fact, the reason why HP co-founded a Compliance Scheme is due to the fact that the company, together with the other co-founders (Sony, Electrolux, Braun), believed that the most efficient system was not a monopolistic one, which means having only a public Compliance Scheme responsible for handling the e-waste flows, but a competitive industry with different Compliance Scheme competing for optimizing the service with the lowest cost, the best quality, etc. This is working well for the electronic waste, and it has allowed companies to reduce the costs for the service, while in countries with a monopolistic system costs are higher for similar environmental quality. .

E: The Directive related to the batteries is very similar to the one for the electronic waste. It is more recent and it has assured the creation of a competitive system also in this industry. As a result, every type of battery is collected and the management of the waste collection is improving exponentially.

F: But does HP, being a co-founder of ERP, still have to pay a fee for the service?

H: The producer of waste has to pay a fee which is dependent on the amount of waste that it has produced. This happens indistinctly to each producer. Being shareholder of a Compliance Scheme or only being registered with a Compliance Scheme does not change the process. However, it might change the cost per kilo that the company has to pay to the Compliance Scheme. A company like ERP was founded in order to provide top service without making profits, limiting the costs for the producers that finance it. For other Compliance Scheme the approach is highly different.

E: There is also a difference between the different Compliance Schemes. Companies registered with some Compliance Schemes usually pay for the quantity of products sold in the market, which means anticipating the costs of collecting them.

H: As an example, if this year you sell 100 but only 20 of the amount sold is collected, the cost paid is different depending on whether the company is registered with a Compliance Scheme or another. In the case of HP, the company pays only for the amount of waste withdrawn (20 in this example). On the other hand, if a company is registered with a Compliance Scheme who invoices on a put-on-market basis, it pays up to 100% now and the scheme creates a reserve which will be used in the following years when the products sold will return as waste. Clearly this is not convenient for those producers, but the majority of them do not know it since they do not investigate well enough.

F: But does ERP gain a profit from the recycle?

E: For sure ERP gains money from the recycle activities, however it never pays dividends. The entire margin is completely reinvested in cost reduction or in public awareness campaigns, for sensitizing consumers. This is due to the fact that people still do not know how the e-waste process works, and therefore the recovery rates are quite low. As a consequence, the more people correctly recycle, the more advantage has the Compliance Scheme in recycling, due to economies of scale.

F: Do you think it will be possible in the future to provide dividends to shareholders?

E: No. The gain for the shareholders is given by the competitive prices for the recycle activities.

H: Yes, not dividends, but the gain is the lower cost paid by HP. This also results in a competitive advantage, since competitors using different schemes could pay more for the same service.

E: Moreover, in some countries in the contract signed by the members it is explicitly written that ERP is a non-profit company.

F: Do you maybe know which collective system is used by Dell?

E: No.

F: Do you see any new trends in the future for the management of e-waste? RFID, for example.

H: RFID would mean obliging all the producers in the world to insert a chip in every single product. It is not probable that it will be implemented. For sure not in the short time, maybe in the long-run. However, the individual responsibility is one of the goals of the Directive, also because it incentivizes companies to create better products. In fact by creating better products that last a longer time, companies pay less for recycling the waste. Despite this, today there is not an advantage for companies, it is instead a disadvantage for companies to improve the life of products since they pay for the recycle of the others.

F: Is the market share the only method used for defining the individual responsibility?

H: Also the sampling method is utilized: some inspections are conducted in some collection centers to see the distribution of waste per brand. In some countries this method has been utilized, and this is the most realistic possibility for defining the individual responsibility as closest as possible to reality.

F: What about screening the products at the collection centers once they have been received?

H: I do not think this can be done in practical terms. You would need a lot of resources and competences since sometimes products are received in bad conditions and it is therefore difficult to define the producer. Moreover, there is a large number of producers so it is difficult to identify all of them.

F: Talking with an alderman responsible for a municipal collection center I was told that they cannot accept equipment in bad condition.

H: I do not think this is realistic.

E: Also because their goal is to collect the waste.

F: What about the retailers? Do you have special agreements with them for the recovery of the products?

H: The producer is not directly responsible for collecting the waste at the retailer site. The retailer organizes collection points which are assigned to different Compliance Scheme by the CdCRAEE. Moreover the Compliance Scheme does not have a direct contract with the retailer, but it has it through the CdCRAEE.

F: But I saw that some retailers offer a coupon for every product returned.

H: This has nothing to do with the producers or with the Compliance Scheme. It is just a marketing initiative of the retailer in order to attract customers to the shop. Once a person is at the shop, it is difficult that it leaves it without buying something.

F: But do retailers gain efficiency awards depending on the number of products withdrawn?

E: The efficiency awards were created for the municipal collection points not for the retailers, in order to incentivize a good collection in terms of quality, of higher availability (opening hours) to citizens, of better replenishment of the baskets for the waste. So the awards have the goal to improve the quality of the collection of e-waste by the municipalities.

H: In order to attain a better quality, the Compliance Scheme pays the awards to the municipalities. This can be seen as a compromise between the municipalities and the Compliance Scheme, since the municipalities had no incentive to create and maintain a good collection point. The awards are however not given to the retailers. If a retailer withdrew more equipment than another one, its only advantage is that it has attracted more customers to the shop.

F: How does it work, in practical terms, the "one against one" regulation? Are retailers obliged to ask customers to deliver their old equipment to retailer when they are buying a new one?

E: No, it is the customer that spontaneously asks the retailer to recycle its old equipment at the moment of purchase. And as a consequence, the retailer is obliged to accept it. However, they don't have to accept the "one against zero", which means that if customers want to bring an EOL product to them, they have to buy a new one.

F: Are all the products received by retailers sent to recycle or are some of them returned to the producer for refurbishment?

H: For sure not to the producer, since as you might have noticed all the brands are put together.

E: Also be careful, because once you choose the "one against one" solution then the equipment is categorized as waste.

F: So is the customer the one defining whether a used equipment is a waste or not?

E: Yes.

H: It is the customer that decides whether the product is a waste. It is the attitude of the customer towards the used product to define whether it is a waste or not. And there is not a different option than recycle when the product is categorized as waste.

F: So if I buy a new laptop and I decide that I want to throw it away, I can just bring it to the collection center and it will be recycled without a screening?

E: Yes, you are the one defining whether a product is a waste. I think that the only entities allowed to screen the products are some treatment companies.

H: However, treatment companies also have to consider if it makes sense to screen products for refurbishment since this process adds costs to the products and companies have to find people able to sell them.

F: Are the HP Technology Renewal Centers directly managed by HP or are they outsourced to other companies?

H: I do not know but it is a marginal business for HP and it is something that has nothing to do with EOL products. These centers are used only for returned leased products which have been financed by HP Financial Services. So the Renewal Centers receive the products at the end of the lease period, and after evaluation they decide if they refurbish them and then resell them again. The waste of professional customers is not considered in this flow.

F: So the Asset Recovery Service Team does not screen the returns at the client's site?

H: It can be done. For example it might happen that an account manager tells a professional client which products can be assessed for trade-in and which should be recycled. However, this does not mean that the products recommended for trade-in will be accepted by HP. Moreover, usually HP is not involved with these processes since it does not trade used products. The trade-in option instead consists in giving back to private customers an amount of money when buying new products and returning used ones during a commercial offer. This process is promoted and financed by HP but the organization acquiring the used products is a third-party that has nothing to do with HP. It can be seen as a service that HP offers to professional customers when changing their equipment, but the process is not managed by HP.

F: But what about the HP Technology Renewal Centers?

H: These centers are used only for large returns in leasing, not for EOLs.

F: So for the EOL products there is no components reutilization?

H: No, it is far too complicated since HP sells high-quality products and not used products. The only possibility is to buy refurbished parts of the PCs at very low price, but these parts are derived only from leasing returns. Professional waste is managed through a process similar to the one for the domestic returns: an external partner is responsible for collecting the waste from the clients' sites. So

the collection is at the site of the client and not at a collection center, for professional returns. Afterwards, the waste is brought to a treatment facility.

F: So concluding, does HP not consider refurbishment for EOL computers at all?

H: No, HP prefers not to do this since the costs are too high compared to benefits, and in any case it should happen before it is waste.

E: There is also a problem of responsibility. Refurbishing a used product and reselling it with the HP name might cause problems in terms of reliability of products and data security.

H: Well you can do that, but it is not convenient to HP, it is too costly to resell a high-quality refurbished product.

F: Do you have some KPIs for evaluating how effectively the recycling process is handled?

H: We do not have them; ERP has them for sure and they have commitments with HP.