Master thesis

# Innovation through competence-based acquisitions: The case of Synopsys

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# Chapter 1 Abstract

This thesis explores how high tech companies can use competence-based acquisitions to create value in their innovation strategy. A broad litera¬ture review forms the foundation for the development of an integrative model on effective technological acquisition (ETA). The developed ETA-model incorporates recent research on effective integration, high tech industry dynamics, and corporate strategic acqusitional competences. By utilizing a processual view on acquisitions, the model is used to analyze acquisitions on three levels: process, individual and structural. The ETA-model is tested and evolved using a sample of 46 acquisitions conducted from 1994 to 2012 in the highly technological advanced and competence-dependent Electronic Design Automation (EDA) industry.

The thesis contributes to the established body of Merger and Acquisition (M&A) literature with a more processual view on acquisitions and integration within several topics. This thesis clarifies that a high tech industry's Human Capital can be effectively optimized through acquisitions. This process can create value, and it is found that high tech companies are able to develop and use acquisition competences to innovate. Thus, acquiring competences and technology can be an effective high tech innovation strategy. On the other hand successful acquisitions will depend on firms having complementary assets. These findings are linked to technological roadmaps and business ecosystems, and show how these concepts can guide and enhance high tech acquisitions. The thesis also finds that in order to create value from acquisitions, high tech acquirers must prioritize suitable integration processes by focusing on the level of integration, which dictates the integration speed.

# 2 Introduction

To scientifically understand the dynamics of innovation, the fastest developing industries are particularly interesting. These industries can magnify dynamics of interest, enabling researchers to gain a better of understanding of specific phenomena. The aim of this thesis is to analyze how high tech corporations effectively innovate by continuously acquiring key competences.

The research team chose the Electronic Design Automation (EDA) industry as an example of an industry with great impact on our society and economy, and where new and rapid innovation strategies played an important role. The profitable, but competitive, EDA-industry contributes with an interesting phenomenon; Here, acquisitions of successful engineering teams have proven to be a highly effective innovation strategy. This phenomenon will be analyzed from several angles to create an integrative model that can convey this strategy and make it available to other industries.

The EDA-industry produce design tools that enable the development of Integrated Circuits (ICs), the hearts of computers, smartphones, and all other IT-infrastructure. This small, specialized sub-industry has to keep up with the overall integrated circuit industry, by providing software to large international that develop and produce the ICs that run every electric utility around us. Hence, modern EDA has made a lot of products possible. If every chip had to be designed and produced manually, consumer-grade information systems and hardware would be very scarce. This thesis is a good example of our society's dependence on EDA. This thesis is written, coordinated, Dropboxed and Skype-interviewed, using several computers in several countries. Therefore, what you are reading is not only research on EDA, this is EDA enabled research.

*"As soon as there is a chip, EDA is involved" - INTV 4(2013)*

In a broader perspective, the ability to produce the most effective and advanced IC determines much of our future society. With IC integrated in nearly all aspects of modern warfare, from modern assault rifles over missiles and defense systems to pure cyber warfare, it is not just a question of who can produce the best ICs - essentially EDA can be a question of security policy. On the other hand, with the leap in the development of ICs that EDA already has caused, science is only scratching the surface of possible peaceful applications of ICs. Today, all of us use and rely on EDA design in most of our daily lives, and this trend seems to be accelerating.

This thesis will begin with a review of relevant literature, resulting in a theoretical model, integrating a processual viewpoint to cover the acquisition integration. This makes it possible to analyze the importance of human capital and organization experience within acquisitions.

The analysis of this thesis will use interviews as primary data, and look at the importance of technological complementarity and how acquisitions affect innovation performance. Furthermore, acquisition strategy will be linked to an ecosystem analogy and technological roadmaps to show how this can enable effective innovation.

### 2.1.1 The strategy of innovating through acquisitions

Acquisitions are primarily known for their ability to facilitate entry into new markets and their effectiveness in achieving economies of scale and scope (Haspeslagh and Jemison, 1991). Furthermore, technologically rich acquisition targets provide opportunities for organizational learning by exposing the acquirer to new and diverse knowledge (Ghoshal, 1987). This thesis directs its attention towards acqusition's effect on innovation. Research has shown that merger and acquisitions can be a powerful innovation strategy in technologically fast changing environments (Mayer and Kenney, 2004). Still, little research has shown how this is done best and whether this is managed with success by any industry. Moreover, much of the research on acquisitions has focused on qualitative financial evaluations of successful acquisitions (Hitt et al, 2001). Thus, implying the need for research examining other success factors (Miller and O'Leary, 2007)

Successful innovation through acquisitions of competences is a strategic choice for a company. One reason for the acqusitional innovation strategy is the differing advantages of large and small companies in different stages of the innovation process. Small companies are often more efficient in producing innovations and are often more radical, whereas larger companies are more likely to have a better access to product markets using economies of scale and scope (Kleer and Wagner, 2012). Hence, a successful innovation effort through acquisition relies on a clear strategy for all players.

### 2.1.2 The importance of the integrated circuits and EDA

Since ICs make up all electronic utilities, all of the industrialized parts of the world relays on this industry. Not only do everyone rely on ICs, we are able to observe the rapid phase of technological development turned into innovation in computers, smartphones etc. IC R&D spending alone accounted for $53.4 Billion in 2012 (Lineback, 2012). With this rapid development comes heavy investments in capabilities and technology (ibid.).

The IC industry also offers a lot of variety. Software and hardware innovations differ, and so do many of the scientific and managerial challenges behind them. Some niche industries are developing very fast, and some are capitalizing on prior investments and developing relatively slow. Since the hardware-oriented part of the IC industry also involves a lot of production and physical supply management, this thesis will zoom in on the software behind, by magnifing the knowledge-intensive innovational effort.

The preliminary search for a suitable field led to the Electronic Design Automation (EDA) industry. This industry displays some interesting dynamics, through the use of acquisitions as the main driver for innovation. The EDA industry produces software for designing and testing ICs. Hence, this industry is only concerned with the production and application of technology to large B2B customers, and development is so fast that only the best in the business can keep up (Vleeschhouwer, 2012; Kleer and Wagner, 2012). EDA development is also very complex, and therefore emphasizing the need for advanced and scarce competences (Kleer and Wagner, 2012). In the EDA industry markets, industries and researchers must organize themselves in the most effective manner to overcome the challenges of resource scarcity, and this sheds light over a particularly interesting part of innovation dynamics; gaining competences via acquisitions (ibid.).

## 2.2 Problem identification

Few acquisitions create value for other than the shareholders of the acquired company (Hitt et al., 2001), and empirical studies have indicated that every second post merger integration process has negative outcomes for the acquiring company (Gerds and Schewe, 2009). However, at the same time research has also shown that the integration process of the acquired competences can be the best opportunity to create value (Haspeslagh and Jemison, 1991). This indicates a clear need of more research on how to create value in acquisitions through an effective integration process.

### 2.2.1 Research question

Growth through acquisitions has become a common strategy within some high tech industries (E.g. Mayer and Kenney, 2004; Ahuja and Katila, 2001). Especially the Electronic Design Automation (EDA) industry has experienced consolidation and changes in the competitive environment as a consequence of the many acquisitions (Gary Smith, 2011). In this industry most of the acquisitions have been aimed at acquiring new competences, both technical (new technologies, IP blocks) and new knowledge (new human resources).

The aim of this thesis is to analyze innovation strategy in competence-based acquisitions in the EDA industry, using the biggest company, Synopsys Inc., as a single case study. The overall goal of Synopsys acquisition strategy is to broaden and enhance a technology portfolio, which aims to create a complete software suite of all necessary software tools to design microchips (INTV 6, 2013).

Hence, this thesis will answer the following research question:

***How can high tech companies use competence-based acquisitions in their innovation strategy?***

The *Literature Review* is summarized in a theoretical model. One sub question for each of the six elements of the model is developed to ensure the foundation of this central model throughout the analysis.

The six elements of the model are; *Human capital, Learning from experience, Complementarity, Innovation Performance, Technological fit, and Integration process.* The sub questions related to each subject, respectively, are:

*1. How does Human Capital affect competence-based acquisitions, and how is it managed?*

*2. How can organizational experience with competence-based acquisitions be used strategically?*

*3. How can acquisitions secure complementary technological and organizational assets?*

*4. How can competence-based acquisitions enhance overall innovation performance?*

*5. How can ecosystems and technological roadmaps enhance competence-based acquisitions?*

*6. How does the integration-speed and-process influence competence-based acquisitions?*

### 2.2.2 Research outline

Figure 1 (see p.9) depicts a graphical representation of the disposition of this thesis. The first module, *Research and Background*, covers the *Introduction*, the *Literature Review,* and the *methodological* thoughts. The literature review (chapter 4) is based on existing research on competence-based acquisitions. The chapter is twofold, with one section reviewing the original and underlying ideas to the present line of research, the other presenting recent findings on relevant sub-subjects. The *Literature Review* is deduced into a model for *Effective Technological Acquisition (ETA)*. Methodically, this thesis uses a critical realist approach, with a single case study to refine existing theory and develop new recommendation for the use of competence-based acquisitions as an innovation strategy. The analysis is based upon 46 acqusitions conducted from 1994 to 2012.

The *Research Objective* (section 2.2) divides the analysis into two chapters. The first part (Chapter 5) analyses the case-company and -industry and the case company's acquisition history. Results provide rich insights into how high tech innovation can be driven by technological acquisitions. In the second part of the analysis (chapter 6) the six elements of the ETA model are applied to analyze acquisitions of the case company. The results are presented in the final chapters, *Discussion, Conclusion and Future Perspectives*. *The Discussion* (Chapter 7) builds arguments around the findings of the analysis, categorizing them into three groups; *Supportive Findings, Contradictive Findings, and New Findings*. All findings are discussed to see if they can be generalized to other high tech industries. The thesis develops some new additions to the body of literature that seem to be generalizable and identifies new avenues not covered in existing literature. This section is finalized through a discussion of the altered version of the ETA model, which incorporates changes and additions derived from the previous parts of the discussion. *Future Perspectives* (chapter 9) presents the managerial implications of the ETA model are concluded and suggestions for practical application are presented, for managers to be able to maximize the value creation through effective integration and utilization of acquired competences. Finally, suggestions for further research summarizes areas of interest in need of further investigation as identified in the discussion.

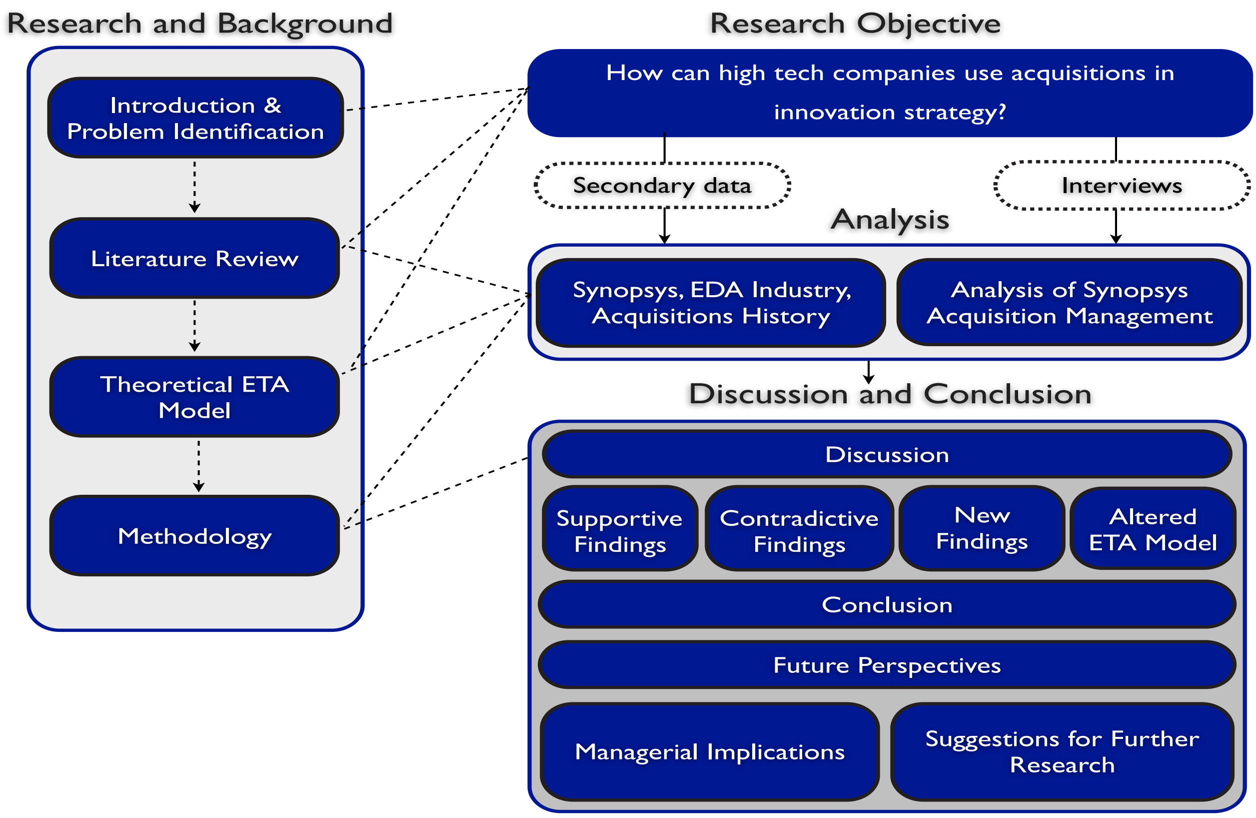


*Figure 1 Graphical outline of the disposition, developed by the authors*

## 2.3 Delimitations and assumptions

This thesis will not cover the reasoning behind specific acquisitions, nor the financial outcomes. As emphasis is put on the integration process, the thesis mainly rest upon internal information obtained through qualitative research methods. Much of the quantitative data on acquisitions in Synopsys are highly classified and not available to researchers. In addition, internal managerial considerations and organizational politics make internal data unreliable in this context. Public data, such as annual reports or press releases, are also not suitable as a single source of information as they are widely used strategically as a means of communication and signaling, which is why a data triangulation is applied (see chapter 4). Financial data have also not been analyzed since global accounting practices differ. Prior research has mainly focused on financial evaluations of capital investments (Miller and O'Leary, 2007). However, as pointed out by Miller and O'Leary (2007), there is a need for more research on other aspects of capital investments. In this thesis public avalible information on acquistion from 1994 to 2012 is used. Acquisitions conducted by Synopsys before 1994 are not covered in this thesis due to lack of publicly available information and interview sources. Thia paper focuses on the integration of acquried companies, and therfore not the transaction costs accured in the planning phases of the acqusition.

We assume that an effective innovation process will result in value creation. Moreover, it is assumed that the information obtained though interviews is correct. However, to ensure the validity *data triangulation* is applied. This point will be expanded upon in chapter 4 *Methodology.*

## 2.4 The Research process

Figure 2 on the following page coordinates the research process of this thesis, measuring time and Bloom's Taxonomy (Anderson and Sosniak, 1994). The horizontal size of a chapter relatively describes the time used, whereas vertical order and placement, describes the taxonomic level (ibid.). The process has been sequential in terms of the writing process, but with many iterative elements as the process revealed insights and possible additions. The top of the figure describes the processes that have supported the research. The research began with finding a suitable industry and case company for this study. After two weeks a case-company and –industry was chosen, and the research team spend another two weeks investigating the industry, technological linguistics and products. After one month a wish list for data collection was formulated, along with research question and two pilot interviews. Based on insights from interviews and the literature review, the research question was refined twice. Moreover, the ETA-model was revised three times with minor changes to name, order and *finally*, to the contents (see section 7.5)

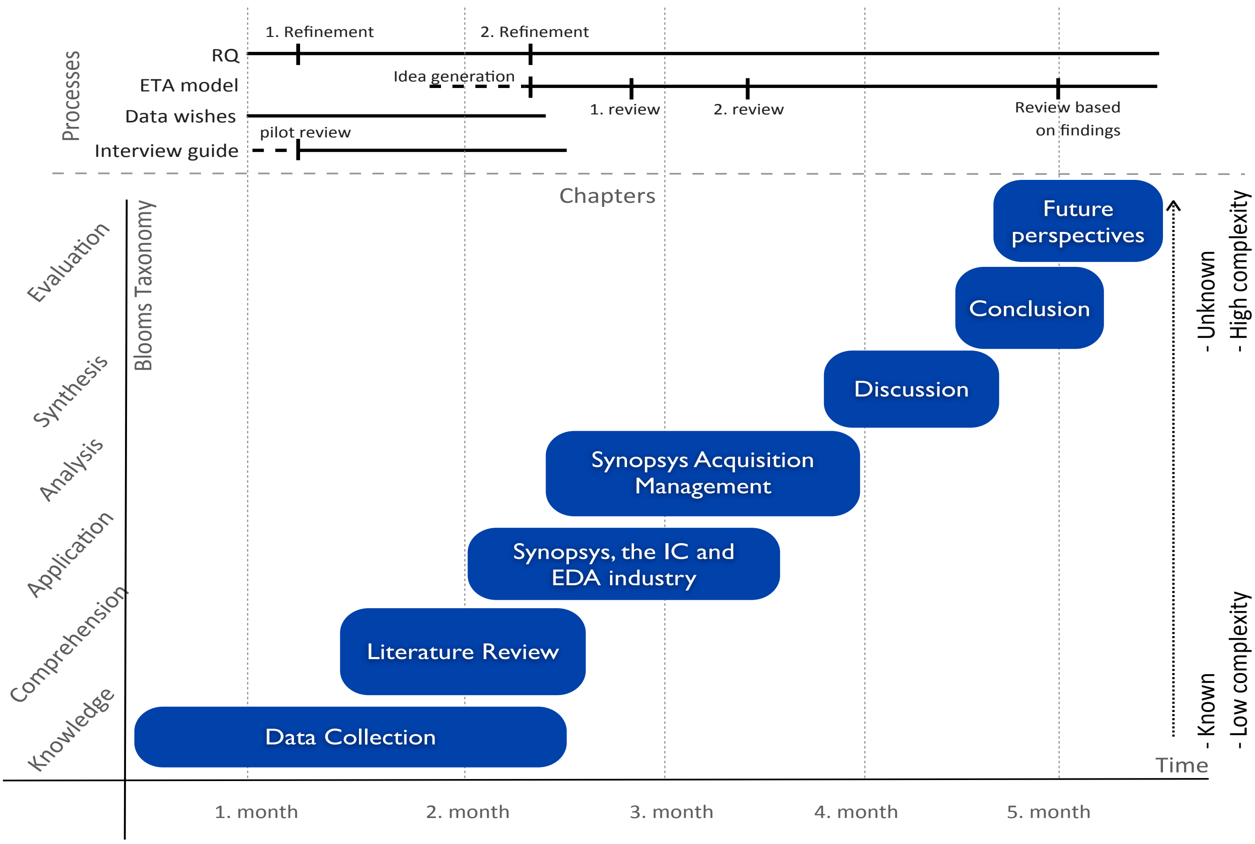


*Figure 2 the research process, developed by the authors*

## 2.5 Standing on the shoulders of giants

*"The whole is greater than the sum of its parts"*
*- Aristotle*

This notion by Aristotle's is the source of inspiration for this study albeit from a perspective of contemporary processes. The thesis will draw on Haspeslagh and Jemison's (1991) notion that acquisition is not just neoclassical economic study but a process that can create value. This line of thought is further developed by a review of contemporary research, drawing from a wide body of literature to show why the recommendations from Haspeslagh and Jemison (1991) are still highly relevant as pointed out below.

In order to narrow down the search field, the initial selection of relevant articles was conducted by deploying two selection criteria. *First*, the articles had to cite Haspeslagh and Jemison´s work (1991), as this is the most cited and one of the most influential works within M&A research according to the findings of Santos et al. (2012). *Secondly*, focus was put on articles from Strategic Management Journal, which is found to be the most important journal for M&A research among the 16 highest rated Academic Journals by Santos et al. (2012).

Within a sample of 53 academic articles, only 21 articles focusing on the post acquisition integration was included in the initial *Literature Review* due to the scope of this thesis (Wiley.com, 2013). Among these articles, six were not included in the literature review as they were not aligned with the research objective and did not cohere with the six reoccurring elements identified in the remaining literature.

Furthermore, no existing research relates connections between the strategic use of competence-based acquisitions as an innovation strategy to the effects of ecosystems and technological roadmaps. These papers were chosen based on their related and practical importance to high tech industries based on insights gained through the interviews. Hence, the *Literature Review* has been revised based on practical insights from the interviews conducted. Moreover, fellow researchers have suggested additional theories from other journals ensuring a well-documented framework for the theoretically deduced ETA model (see figure 5). Based on the feedback and improvements of the theory review, from both fellow researchers and through interviews, the theoretical review has been further strengthened as a result of these continuous iterative feedback loops (Latour, 1987).

## 2.6 Conceptual clarification

**Acquisition:** When one company purchases another and completely establishes itself as the new owner (Haspeslagh and Jemison, 1991). Academic literature often fails to distinguish between a merger (of equals) and an acquisition. Both are frequently used interchangeably or just referred to as "M&A" (E.g. Angwin, 2004). As a merger presupposes all actors to be equal, it is irrelevant to this study.

**Capability:** A potential to acquire a specific ability or skill that will be helpful in a task, and can be individual as well as collective. With time and effort, capabilities can develop into competences (Graebner, 2004; MacMillen et al., 2000).

**Competence:** A competence is a cluster of related knowledge and skills that affect a major part of a job that can be measured against some sort of occupational standards, and can be improved by training and development. As competence covers know-how and skill, this thesis uses the term to describe the quality or state of being functionally adequate or having sufficient knowledge, strength and skill. The application of competences on a specific challenge can result in a technology (Coff, 2002; Afuah and Utterback, 1997; Zollo and Singh, 2004).

**Exploitation:** Innovation strategies that includes refinement of choice, production, efficiency, selection, implementation and execution (March, 1991).

**Exploration:** Innovation strategies that includes search, variation, risk taking, experimentation, play, flexibility, and discovery (March, 1991).

**Human Capital:** The competencies and knowledge embodied in the ability to produce economic value, including R&D (Coff, 2002)

**Innovation:** The process of translating an idea or invention into a good or service that creates value and for which a customer will pay (Ahuja and Katila, 2001; Cassiman and Veugelers, 2006).

**Knowledge:** The theoretical or practical understanding of a subject either implicit (practical skill or expertise) or explicit (theoretical understanding). Knowledge acquisition involves complex cognitive processes: perception, communication, association and reasoning (Ranft and Lord, 2000; Makri et al., 2010).

**Technological acquisitions:** Acquisitions that are motivated by a technological component of the acquired company's assets (Ahuja and Katila, 2001).A technological component is a concrete technology and the competences behind.

**Technology:** The material and immaterial application of knowledge (competence) to achieve value by solving real-world challenges. Advanced technology (high tech) is the most advanced technology available, within a given subject (Zollo and Singh, 2004; Puranam, Singh, and Zollo, 2003).

# 3 Literature review

This *Literature Review* is separated into two parts built upon the principles and results presented in Haspeslagh and Jemison's work Managing Acquisitions - Creating Value Through Corporate Renewal, from 1991. The first section summarizes important points from this ground-breaking work, which is still relevant in current research and in this thesis.

In the last part of the *Literature Review, Recent Research,* the implications from the first part are used to account for the past 20 years of related research on to high tech acquisitions published in international well-aclaimed scientific journals. The results are grouped into six themes, and sought to construct an integrative model that guides this analysis of successful competence-based acquisitions in technological advanced industries.

## 3.1 Fundamental research on acquisition management

Haspeslagh and Jemison (1991) contributed greatly to the way acquisitions can be perceived in a strategic context through a thorough review of literature and analysis on contemporary cases. The research results emphasize the importance of the integration process in strategic acquisitions. Haspeslagh and Jemison (1991) describe the whole acquisition process from the first decision through the conduction of the acquisition and into the integration. They state that every step in the process is vital for the outcome of the acquisition.

*"The key differences between acquisition success and failure, lie in understanding and better managing the processes by which acquisition decisions are made and by which they are integrated"*
*- Haspeslagh and Jemison, 1991:3*

This was contrary to the contemporary neoclassical economic theory, which was generally accepted at the time. Haspeslagh and Jemison's (1991) main argument is that a process-based view of integration is relevant to consider, if the entire acquisition process and the implementation timing performance is to be understood and enhanced. Hence, the actual value creation in acquisitions does not stem from the interdependencies of resources, but from how such interdependencies are managed post-merger. Implying that the value of the acquisitions is first generated after the actual accession (Haspeslagh and Jemison, 1991). The process perspective shifts the focus from an acquisition's result to what cause these results: the transfer of capabilities that will lead to competitive advantage. In the process perspective acquisitions are a means to the end of corporate renewal. It is not enough to look upon fragments of the process, but one must take the whole process into consideration to understand that corporations can renew themselves through acquisitions.

*"The transaction itself does not bring the expected benefits; instead, actions and activities of the managers after the agreement determine the results"*
*- Haspeslagh and Jemison, 1991:12.*

Haspeslagh and Jemison´s work is important for scholars. As it creates an understanding of the dimensions of the integration process and in relates strategic objectives driving the acquisition to key managerial decisions made in the post-acquisition phase. The research can be used by managers to understand the relevance of the processes firms use to select their acquisition targets. In practise that is; how to negotiate the agreement to purchase or to merge, decide on how to manage the post acquisition transition phase, and interact with the acquired firm to implement the selected integration strategy. They also indicate some critical dimensions of the post-acquisition decision-making process, such as the extent of functional integration. Haspeslagh and Jemison's book was based on two major research projects. Interviews with over 300 executives of 20 acquiring companies based in 6 countries were conducted. Deals ranged in value from $3 million to over $1 billion and occurred in 10 different countries and in many industries including: chemical, banks, food, steel, and financial services (Haspeslagh and Jemison, 1991).

*"Integration is the key to making acquisitions work. Not until the two firms come together and begin to work toward the acquisition's purpose can value be created"*
*- Haspeslagh and Jemison, 1991:105*

Based on their findings from previous studies of post-acquisition integration, Haspeslagh and Jemison (1991) developed a capability based contingency framework identifying three different approaches on how to integrate merging firms; *Absorption, Preservation and Symbiosis.*

The choice of approach depends on the distinctive needs for:

a) Strategic interdependence, needed to create synergies between the two firms

b) Organizational autonomy required to extracted and transfer key capabilities

In the *Absorption* approach, value is realized through the realization of synergies created through rapid consolidation and rationalization due to the similar business context of the two firms.

The *Preservation* approach is applicable to situations where the firms need to be kept separate, for the acquiring firm to be able to accumulate learning and knowledge in order to successfully transfer resources and new competencies (Haspeslagh and Jemison, 1991). Moreover, the separation is needed for the acquiring firm to gain an understanding of the target's resources and competences, their logics, and impact on the target´s organization and culture (ibid.). Separation can be used to identify the key employees, who can ensure a successful transfer of resources and competences (ibid.).

Finally, *Symbiosis* is created through a balance between organizational autonomy and strategic interdependence. This approach is used when a considerable amount of capabilities needs to be transferred and the organizational context must be kept intact to obtain the full value of these capabilities. *Symbiosis* is initiated using a *Preservation* approach to identify synergies, complementary resources, and competences and gradually integrate these by increasing the interdependencies of the two firms.

Besides the aforementioned framework, Haspeslagh and Jemison (1991) distinguish between 3 different types of acquisitions: *Domain Strengthening, Domain Extension and Domain Exploration.*

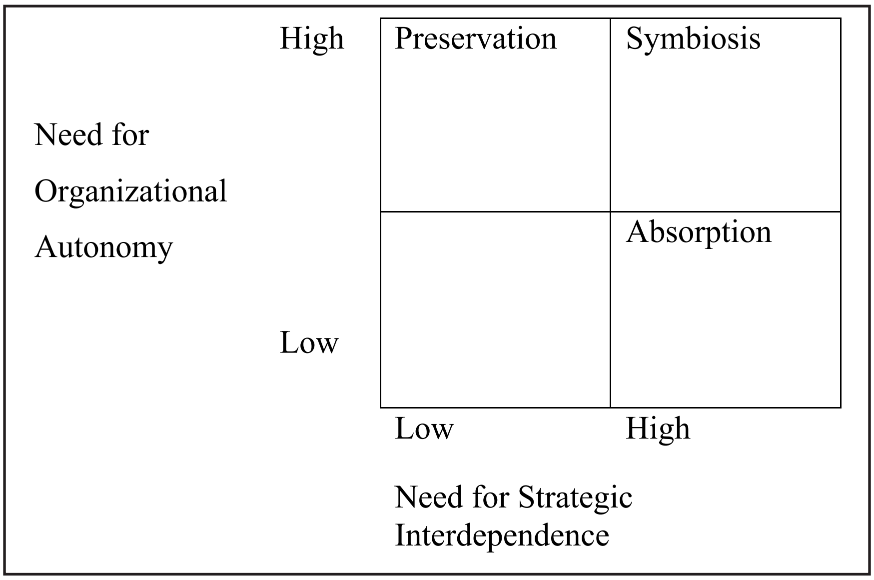


*Figure 3: Adopted from Haspeslagh and Jemison (1991)*

*Domain Strengthening* acquisitions are mainly aimed at defending the firm's market position through acquiring competitors with similar or overlapping products (Haspeslagh and Jemison, 1991). Whereas, *Domain Extensions* extend capabilities in current market or expend capabilities in new adjacent markets where existing market knowledge can be utilized (Haspeslagh and Jemison, 1991). Finally, in *Domain Exploration* acquisitions firms are moving into new markets requiring new capabilities, but were management skill can be utilized to create rapid development or more disciplinary management in unrelated businesses (Haspeslagh and Jemison, 1991).

Synergy with a human capital-intensive firm may require knowledge transfers that are difficult to predict. Acquirers may wish to transfer knowledge into the target or to import complementary knowledge from the target. The first may allow the buyer to exploit its existing capabilities while the latter involves building new complementary resources (Haspeslagh and Jemison, 1991). When the focus is on post-acquisition integration, *Human Capital* poses serious hazards in corporate acquisitions. The acquiring firm damage the target's resources in the process of using and redeploying them into the acquirer's businesses (ibid.).

*"All value creation takes place after the acquisition"*
*- Haspeslagh and Jemison, 1991: 129*

Corporate acquisitions might seem to be an attractive way to build a competitive advantage, but whether the acquiring firm can successfully transfer and integrate the new know how in new setting is unsecure (Haspeslagh and Jemison, 1991). Haspeslagh and Jemison's (1991) main argument is that value creation happens after the deal. The value created depends on the strategic and organizational fit of the two firms rather than on their individual resource profiles (ibid.). Acquirers must integrate acquired firms in order to commercialize their technologies in a coordinated manner; at the same time, they must preserve organizational autonomy for acquired firms in order to avoid disrupting their capacity for continued innovation (ibid.). Managers have to ensure that strategic capabilities of the target are either transferred efficiently or effectively retained in a semi-independent target.

Haspeslagh and Jemison (1991) defined 4 different types of strategic capability transfer applicable to all acquisitions no matter the type or strategy: *Operational Resource Sharing, Transfer of Functional Skills, transfer of General Management Skills, and Combination Benefits.*

*First*, for *Operational Resource Sharing* to make sense, the hidden costs need to be outweighed by the benefits of the combination through sharing (Haspeslagh and Jemison, 1991). The challenge arrives when combing the resources and coordinating their joint use, increasing either economics of scale or scope (ibid.).

*Secondly, Transfer of Functional Skills* is characterized by horizontal interactions between the firms at an operational level (Haspeslagh and Jemison, 1991). Due to the lack of direct hierarchical relationships, managers tend to be less motivated towards this type of learning (ibid.). In capability transfer the long-term source of value creation is created by the effective transfer of functional skills between firms (ibid.).

*Thirdly,* in *Transfer of General Management Skills,* the acquired firm's management practices are typically adapted to those of the acquiring firm such as *Strategic Direction, Resource Allocation, Financial Planning and Control, or Human Resource Management* (Haspeslagh and Jemison, 1991). This transfer can happen through subtle coaching, direct involvement or imposition of systems (ibid.).

Finally, *Combination Benefits* focuses on size-related benefits that require little coordination to be implemented such as increasing purchasing power, increasing market power or the transfer of financial resources (Haspeslagh and Jemison, 1991). As an important part of determining which types of capability transfer to apply, acquirers must also determine the optimal level of interaction between organizations to maximize capability transfer and begin the post-merger integration process in a way that maintains the desired level of interaction (ibid.).

Structural integration, and its converse structural separation, represent two archetypes of post-acquisition organizational structure; either a target firm is absorbed into the acquirer and loses its distinctive identity as an organizational unit, or it is preserved as a distinct organizational entity within the merged firm (Haspeslagh and Jemison, 1991). Eventually, the objective is to create a shared culture between them, so that the target and acquirer are truly a single organization (ibid.).

Acquirers may be able to time their integration processes favorably, where a gradual process of integration follows a period of non-integration (Haspeslagh and Jemison, 1991). Large firms, therefore, can often benefit from specialized departments that focus on integrating smaller targets and become reutilized in making smaller deals (ibid.). Small acquisitions expose acquirers to a limited risk while generating opportunities to expand further (ibid.). With more experience in small deals, acquirers are likely to fine-tune routines and explore selective markets. For large acquisitions, lower integration levels entail more cautious, selective consolidation and preservation of autonomy of units (ibid.).

## 3.2 Recent research on acquisition management

Based on the literature listed in table 1, the findings are grouped in to six different overarching themes affecting the effectiveness of the post-acquisition integration. The themes are *Human Capital*, *Learning From Experience*, *Complementarity*, *Innovation Performance*, *Technological Fit and Integration Speed*. In the following section the takeaways from each theme are discussed and applied in the development of a comprehensive model for successful post-acquisition integration performance.

| Author | Research method | Data set | Findings |
|---|---|---|---|
| **Krishnan, Miller and Judge (1997)** | *Quantitative* | *147 acquisitions from 1986 to 1988. To be able to measure the acquisition performance 3 years after the acquisition.* | *Complementary in the management team have a positive impact on performance, regardless of the type of acquisition.*<br>*Turnover among the acquired top management was found to be negatively related to complementarity, as well as decreasing acquisition performance.* |
| **Garcia and Bray (1997)** | *Literature review* | *Public DOE documentation, CIA literature and scientific literature* | *Documents Roadmapping process.*<br>*Finds that TR can increase coordination internally and externally.* |
| **Capron, Dussauge and Michell (1998)** | *Quantitative. Resource based view* | *253 unique targets and 190 unique acquirers from 1888-92* | *Acquirers transfer R & D resources from the target, redeploy their own managerial and financial capabilities to the target.* |
| **Ranft and Lord (2000)** | *Quantitative* | *89 M&A in high-technology industries from the Securities Data Corp (SDC) Worldwide Mergers and Acquisitions database.* | *Key employees are critical for the successful transfer of technological capabilities. Thus, the retention of these is crucial to gain max. value of the target's capabilities.* |
| **Ahuja and Katilla (2001)** | *Quantitative, econometric approach* | *Patent data used to measure organizational knowledge bases in the global chemicals industry acquisition behavior of 72 firms over a 12-year period, from 1980 to 1991* | *Technological acquisitions increase the acquiring firm's innovation performance.*<br>*Managers underestimate the integration task, even in closely related acquisitions resulting in poorer innovation performance.* |

| | | | |
|---|---|---|---|
| **Arden (2002)** | *No academic analysis. Builds on ITRS* | *Na.* | Presents they way ITRS work, and make knowledge explicit. |
| **Coff (2002)** | *Quantitative, knowledge-based view* | *Based 324 full acquisitions in the years 1988–1989 from the Securities Data Corp (SDC) Worldwide Mergers and Acquisitions database.* | *Experience from similar acquisition is evident in acquiring human capital-intensive targets.* |
| **Paranam, Zollo and Sighn (2003)** | *Quantitative* | *Sample of 207 technology-grafting acquisitions by 49 acquirers in the IT manufacturing sector in the US.* | *Post acquisition integration has long-term beneficial effects on performance but short-term disruptive effects. This effect distorts the potential of advanced products from acquisitions of small firms.* |
| **Graebner (2004)** | *Qualitative, grounded theory* | *Three data sources: (1) interviews with company leaders and investors; (2) follow-up e-mails and phone calls; (3) archival data* | *Acquired leaders play a vital role in the resolving implementation problems. As they are able to facilitate both exploitation and exploration.* |
| **Zollo and Sighn (2004)** | *Quantitative,*<br><br>*Organizational learning, knowledge based approach* | *Surveys conducted in 1996 on 47 US Banking institutions that had completed 577 acquisitions.* | *Acquisition performance is positively influenced by knowledge codification, while experience has a negative effect.*<br><br>*Cost efficiency from integration outweighs the cost of integration.* |
| **Rinne (2004)** | *Literature review.* | *A broad selection of* Technology *roadmap relevant literature.* | *Technology roadmaps connect technologies, products, and markets.*<br><br>*Technology roadmaps have the potential to become the infrastructure for innovation.* |
| **Iansiti and Leviens (2004)** | *Na.* | *Na.* | *Certain business environments can be seen as an ecosystem.* Business ecosystems are characterized by a large number of |

| | | | |
|---|---|---|---|
| **Paranam, Zollo and Sighn(2006)** | *Quantitative* | *207 acquisitions for 49 acquirers in information technology hardware industries from the SDC Platinum's M&A Database.* | *In the integration process the acquirer should emphasize the relative importance of exploitation or exploration rather than integration speed.* |
| **Homburg and Bucerius (2006)** | *Empirical study* | *Surveys from conducted with PMI managers of 232 horizontal merger and acquisitions from 1996-1999. An important limitation of this study is that the data was collected in 2002.* | *Speed of integration may be highly beneficial or harmful to the success of the post merger integration, depending on the internal and external relatedness of the target and the acquiring firm.* |
| **Puranam and Srikanth (2007)** | *Quantitative* | *97 acquisitions by 43 acquirers between 1988 and 1998 from SDC Platinum's M&A database.* | *Acquisitions allowed acquirers to utilized the targets existing knowledge to enriching their own innovations processes.*<br><br>*Acquisitions hamper the target firm's ability to create future innovations.*<br><br>*Experienced acquirers to be able to diminish the obstreperous effects cause by loss of autonomy as a result of post acquisition integration.* |
| **Tomi and Keil (2008)** | *Quantitative* | *Publicly disclosed acquisitions of 611 public U.S. acquirers operating in seven chosen industry sectors between 1 January 1990 and 31 December 1999 from Thomson Securities Data Corporation Platinum* | *Firms can have the capability to manage acquisition program.* |
| **Finkelstein and Kim (2009)** | *Event study.*<br><br>*Resource based view and organizational* | *2204 acquisitions in the US banking sector from 1989 to 2001 as well as interviews with 11 senior level managers in 8 banks.* | *Acquisition performance is increased by strategic complementarity. Internal M&A units in charge of the integration process show similar results.* |

| | | | |
|---|---|---|---|
| **Makri, Hitt and Lane (2010)** | *Quantitative.*<br><br>*Resource based view as well as knowledge based approach* | *95 deals consisted of 24 in drugs, 27 in chemicals, and 44 in electronics concluded 1995 from the Securities Data Corporation database (SDC).* | *Post- acquisition innovation performance is positively affected by complementary technological and scientific knowledge.*<br><br>*Similarity in scientific and technological knowledge was found to produce incremental change.* |
| **Ellis, Reus. Lamont and Ranft (2011)** | *Quantitative.* | *305 domestic deals in US exciding US$100 million, in which the acquirers owned 100 % ownership after the deals, from SDC Platinum database with a sample period of 1995–98.* | *Experience in large related M&As increases the possibility of success in future ones. While experience in small M&As has decreasing the possibility.* |
| **Muehlfeld, Sahib and Witteloostuijn (2012)** | *Quantitative.* | *4973 acquisitions attempted by 1964 companies in the new paper industry in the period of 1981-2008 from Thomson.* | *Experimental learning from previous experience only affects future acquisitions with the same context*<br><br>*Found learning from successful acquisitions to positively influence the success of future acquisitions.* |

*Table 1: Literature on post-merger integration*

### 3.2.1 Human capital

The strategic importance of retaining *Human Capital* is especially vital for knowledge-intensive acquisitions (Ranft and Lord, 2000; Coff, 2002). The real value from these activities recites in the tacit and social complex knowledge that is embedded in the minds of key employees of the acquired firm (Ranft and Lord, 2000). Thus, the retention of key employees, both management and production, throughout organizations appears to be a critical prerequisite to promote the successful transfer of new knowledge based technologies and capabilities to the acquiring firm (ibid.). Following this argument, Graebner (2004) identified acquired managers as the key to realizing expected value, as well as unexpected resource reconfigurations, defined as serendipitous value.

*"Effective acquired leaders also promote the realization of serendipitous value by identifying opportunities for unexpected resource reconfiguration."*
*- Graebner, 2004; 774*

Ranft and Lord (2000) concludes that the way to retain these key individuals is through intrinsic rewards such as autonomy, status, and commitment by the acquiring firms top management, rather than extrinsic rewards such as bonuses and other economic incentives. Not only do they play an important role in the successful transfer of technologies, key employees are vital in diminishing the acquisition implementation problems, which often occur because of clashes in organizational cultures, systems, or strategies (Ranft and Lord, 2000).

*"(…) Acquired firm's top managers, and the knowledge and skills they possess, often are not the most critical portion of the acquired firm's human capital."*
*- Ranft and Lord, 2000; 312*

In this context, Graebner (2004) found acquired leaders to create value in part by mitigating the potential conflicts between autonomy and integration. The most effective acquired leaders are able to foster multiple points of change within their organizations, including the completion of the acquired technology, the realization of planned synergies, and the discovery of unexpected sources of synergy (ibid.). Acquired leaders can also be a source of internal renewal in the acquiring organization by preventing groupthink (Un, 2010). This coexistence of multiple forms of change suggests that acquisitions can preserve change resulting in both exploitation and exploration innovation strategies (ibid.).

Capron, Dussauge and Mitchell (1998) found that firms too frequently redeploy R&D from targets, and will often transfer managerial and financial resources to targets.

*"Firms frequently redeploy R&D, manufacturing, and marketing resources to and from targets"*
*- Capron, Dusssauge, and Mitchell, 1998; 652*

This redeployment of resources following acquisitions enables the diffusion of valuable business resources throughout an industry (Capron et al., 1998). Thus, a firm can expand the use of strong firm-specific resources by acquiring a competitor and then redeploying resources to the target (Capron et al., 1998). In later research of the redeployment of resources Capron (1999) found acquisitions to provide acquiring firms the possibility to redeploy resources to its target and rationalize its resources as a part of the process positively contributing to acquisition performance.

*"Acquisitions provide firms with opportunities to redeploy resources while rationalizing the assets of the firm receiving these new resources"*
*- Capron, 1999; 1009*

Due to the important role of human capital, there is a risk of paying a premium, which is too high in order to obtain targets in human capital-intensive industries (Coff, 2002). This risk can, however, be mitigated by experience in how to acquire human capital-intensive companies (ibid.). This leads to the second theme of successful integration: learning from experience.

### 3.2.2 Learning from experience

Based on studies from multiple industries, Coff (2002) found experience from similar acquisitions to be important for acquiring human capital-intensive targets, as experience reduces the surprises occurring in the integration phase (ibid.).

*"(…) Related experience is only helpful when acquiring human capital-intensive targets."*
*- Coff, 2002; 125*

Drawing on a competence-based approach to corporate acquisitions, Zollo and Singh (2004) found performance to be affirmatively affected by knowledge codification. Which was found to significantly increase as the integration of the two firms intensified (Zollo and Singh, 2004).

*"Firms learn directly by articulating and codifying the lessons they learned from previous experiences, even if they might not be aware of the positive learning spill-overs from these activities."*
*- Zollo and Singh, 2004; 1251*

It is, however, important to note that experience accumulation alone, in the best cases, provides zero value, it has to be codified (Zollo and Singh, 2004). Zollo and Singh (2004) found that cost efficiency from integration outweighs the cost of integration. Despite positive gains from acquisitions, the shareholders of the target firm are the ones obtaining the highest benefit (ibid.). When managing the benefits and creating value from acquisitions, it is essential to ensure the right balance between achieving necessary levels of organizational integration and minimizing the disruptions to the acquired firm, as it affects the success the entire acquisition (ibid.). Ellis et al. (2011) found that due to the integration complexities associated with large related deals, applying acquisition routines from prior small deals that do not compare to this type can be detrimental to post-deal performance. Their analysis of transfer effects on large-scale domestic acquisition performance also found previous experience from large related acquisitions positively affects firm performance, while experience from small acquisitions hurts performance (ibid.). For managers the role of previous experience and its potential pitfalls is important to keep in mind throughout the post-acquisition integration process (ibid.). This is due to the continuous consolidation and fierce completion pressures on managers to utilize their experience to the fullest (Ellis et al., 2011).

*"However, transfer of acquisition routines to a focal acquisition can result in positive, neutral, or negative effects."*
*- Ellis, Reus, Lamont, and Ranft, 2011; 1273*

Making generalized recommendations based on prior experience for different contexts have, however, harmful effects on the acquisition success (Muehlfeld, Sahib, and Witteloostuijn, 2012). The relationship between acquisition capabilities and the management of more complex integration decisions may explain why a large number of integrations are not successful (Zollo and Singh, 2004; Laamanen and Keil, 2008). Still, experienced acquirers have been able to diminish the obstreperous effects caused by loss of autonomy as a result of post-acquisition integration (Puranam and Srikanth, 2007). Hence, it can be argued that firms can have the competence to manage acquisition programs (Laamanen and Keil, 2008). Active acquirers develop program level capabilities for managing their acquisitions as they learn what the optimal number of firms to acquire is, how to time individual acquisitions, and what types of firms to acquire (ibid.).

Ahuja and Katila (2001) found that managers underestimate the vastness of the integration task, even in closely related acquisitions resulting in less efficient innovation. According to the findings of Kim and Finkelstein (2009) as well as, Haspeslagh (1991) an internal unit dedicated to the task of managing post-acquisition integration has positive effects on acquisition performance.

*"A less obvious but important factor that could affect acquisition performance is the presence of an internal dedicated unit entrusted with the task of managing post-acquisition integration."*
*- Kim and Finkelstein, 2009; 642*

Muehlfeld, Sahib, and Witteloostuijn's (2012) studied if experimental learning from acquisitions provided valuable insight into the context-specific and outcome depended theory. The analysis is based on six different acquisition contexts; *intra-industry, diversifying, domestic, cross-border, hostile,* and *friendly acquisitions* (ibid.). Muehlfeld et al.´s findings showed experimental learning from previous experience only to be affecting future acquisitions with the same context (ibid.). Moreover, the results found that learning from terminated and unsuccessful acquisitions to positively influence the success of future acquisitions (Muehlfeld, Sahib, and Witteloostuijn, 2012).

*"(…) Success experience appears to foster subsequent performance by facilitating the refinement of successful routines."*
*- Muehlfeld, Sahib, and Witteloostuijn, 2012; 957*

In relation to this research, Hitt et al., (2001) found that through acquisitions, organizational learning is created and used to enhance the performance of future acquisitions. Acquisitions may shift the learning from R&D and innovation, creating incentives for "buying" rather than developing competences internally (ibid.). Thus, making it more important for firms to use their experience to create knowledge codification. Leading to the next theme of effects of complementary knowledge on post-acquisition performance.

### 3.2.3 Complementarity

Krishnan et al. (1997) studied complementarity[1] among top management team in post-merger integration. The results provide insights into the importance of diverse functional backgrounds between the target and the acquiring firm. Krishnan et al. (1997) defined complementarity as diverse backgrounds in top management. Their findings suggest that complementary knowledge bases has a positive effect on post-acquisition integration, in both related and unrelated acquisitions (ibid.). Furthermore Krishnan et al (1997) argued that similarity have decreasing effects on post-acquisition integration. Thus, the combination of different types of functional knowledge is creating more value to the acquiring firm. Logically the loss of specific functional capabilities possessed by each of the members in the acquired firm's top management team, has a detrimental influence on post-acquisition performance (Krishnan et al., 1997). This detrimental influence on top management turnover is supported by similar findings in other industries (Zollo and Singh, 2004).

*"(…) Complementarity has a direct impact on post-acquisition performance, and top management turnover has a separate unrelated impact on performance."*
*- Krishnan, Miller, and Judge, 1997; 371*

Cassiman et al., (2005) found similarity and complementarity[2] of the acquirer's and the target's technological knowledge to be important predictors of post-merger innovation effectiveness. When the merged entities are technologically complementary; their R&D productivity increases, due to the realized synergetic scale and scope results (Cassiman et al., 2005). Thus, escalating the motivation for intensified post acquisition R&D activities (ibid.). Cassiman et al., (2005) also found similar technological capabilities to decrease R&D performance. Thus, similarity has severe decreasing effects on post-acquisition R&D performance, resulting in the loss of key employees, limiting the R&D portfolio, and finally downsizing the firm's overall R&D investment (ibid.).

*"When merged entities are technologically complementary, they increase their R&D efficiency, while merged entities which are technologically substitutive decrease their R&D inputs after the M&A."*
*- Cassiman, Colombo, Garrone, and Veugelers, 2005; 213*

Derived from research on integration trade-offs in knowledge intensive acquisitions of technology-based entrepreneurial firms, Puranam et. al, (2003) found value creation in these acquisitions to arise from creating organizational linkages through post-merger integration, between the complementary capabilities of the firms.

The effects complementary has on acquisition performance are further investigated by Finkelstein and Kim (2009). In this study the effects of strategic and market complementarity on acquisition performance in the context of related horizontal acquisitions is investigated (Kim and Finkelstein, 2009). Complementarity is found to have profound effects on the acquisition performance. According to Finkelstein and Kim (2009), acquisition performance is a function of creating synergy from both similarity and complementarity.

*"Within this related industry context, strategic complementarity was positively and significantly associated with acquisition performance."*
*- Kim and Finkelstein, 2009; 640*

Moreover, a too narrow strategic focus causes firms to sacrifice future growth (ibid.) and relaying solely on internal R&D activities reduces the innovation, decreases the development speed and results in more complex, risky and costly R&D (Kleer and Wagner, 2007)

In their study of acquisition activity in high tech industries Cassiman et al., (2005) found technological complementarity to escalate post-acquisition R&D and innovation activities. The important insights relating post acquisition in integration to *Innovation Performance* will be unfolded in the following section.

1 Differs from our use of the term. See glossary for definition.
2 Definition consistent with ours

### 3.2.4 Innovation performance

According to Hitt et al., (2001) the positive relationships between innovation and financial performance are evident in many fields of research. Based on the high risks, low probability of success, and the lengthy time span internal innovation is by some managers considered to be associated with too large risk compared to external innovation (Hitt, Harrison, and Ireland, 2001). Whereas, acquisitions can be used to acquire proven innovations at lower risk, providing the firm with equal or higher financial results, and at the same time decreasing the time to market (ibid.).

The research of Hitt, Harrison and Ireland (2001) has three important conclusions. *First*, as innovation is related to firm performance, a continuous focus on innovation is important to stay competitive (Hitt, Harrison, and Ireland, 2001). *Secondly,* as a part of a focused acquisition strategy firms needs to maintain and enhance innovation (ibid.). *Finally*, under the right circumstances, companies can use acquisition as a strategy to successfully acquire innovative skills and competences (ibid.).

*"(…) Acquiring innovation would allow their firms to enter markets quickly with proven innovations at lower cost to their company and lower risk for the managers."*
*- Hitt, Harrison, and Ireland, 2001; 138*

Ahuja and Katila (2001) applied patent data to measure the organizational knowledge base and the firm's innovation output, which allowed them to analyze the effect of acquisitions on the following *Innovation Performance* of the acquiring firm. By distinguishing between technological acquisitions, where technology was a part of the acquired assets, and non-technological acquisitions where technology was not a part of the assets (Ahuja and Katila, 2001). Technological acquisitions were found to increase the acquiring firm's innovation performance, whereas non-technological acquisitions were found to have no impact (ibid.).

*"(…) Under the appropriate circumstances, even after controlling for innovative inputs such as R&D, acquisitions can introduce a positive shock onto innovation output."*
*- Ahuja and Katila, 2001; 216*

Drawing on the findings of Cassiman et al. (2005), Makri et al., (2010) investigated how relatedness of the target and acquiring firm's scientific and technological knowledge affects post-acqusition innovation performance. Which was found to be positively affected by complementary technological and scientific knowledge, through higher quality, and increased novelty in innovations (Makri, Hitt, and Lane, 2010). While, similarity in scientific and technological knowledge was found to produce incremental change (ibid.). In accordance with these findings, high tech companies should find and acquire firms with scientific and technological knowledge complementing their internal knowledge (ibid.). Thus, basing their due diligence evaluation not only on financial measures, but also on technological and scientific knowledge stocks (Makri, Hitt, and Lane, 2010).

*"(…) High technology firms should search for, identify, and acquire businesses that have scientific and technological knowledge complementary to their own."*
*- Makri, Hitt, and Lane, 2010; 602*

In the implementation of these different knowledge bases, acquiring firm's needs to be aware of the trade-off between coordination and autonomy that underlies different integration approaches (Puranam, Singh, and Zollo, 2006). Implying that the acquiring firm needs to manage both exploitation of their capabilities and technologies in a coordinated way, and foster their exploration capacity by preserving their autonomy (ibid.). Cassiman and Veugelers (2006) found internal R&D and external knowledge acquisitions to be complementary innovation activities. They conclude that the successful innovation depends on the combination of different innovation activities, and creating the right context by carefully managing the innovation process (Cassiman and Veugelers, 2006).

This section has focus on *Innovation Performance* in relation to acquisitions. The following section draws on the findings from the section related to technological acquisitions; to establish how post acquisition *Innovation Performance* is related to industry-wide technological surroundings.

### 3.2.5 Technological fit

To secure effective *technological fit* of acquisitions in high tech industries, technological roadmaps have emerged as an effective tool. A technological roadmaps is a planning tool that identifies precise objectives and helps industry actors to focus resources on the critical technologies that are needed to meet those objectives. This focus allows investments to be used more effectively (Garcia and Bray, 1997). Recent research have found that technological roadmaps enables effective development of high tech industries, by coordinating technologies, products, and markets into one planning tool. This enables acquirers to identify companies with complementary technologies and knowledge (Rinne, 2004; Miller and O'Leary, 2007). Hence, technological roadmaps enables firms to increase the novelty and quality of their innovations, as complementary technical and scientific knowledge increase post-acquisition innovation (Makri, Hitt, and Lane, 2010). Thus, easing the pre-acquisition search process and enabling a better *Technological fi*t of the acquired capabilities.

*"Technological roadmaps have the potential to become the infrastructure for innovation"*
*- Rinne, 2003*

Miller and O'Leary (2007) used the microprocessor industry as a case study, analyzing the role of Moore's law and technological roadmaps as mediating instruments (Miller and O'Leary, 2007).

Moore's law predicts that the device complexity, defined as the number of electronic elements on a IC, for minimizing costs would double every second year (Miller and O'Leary, 2007). His predictions were confirmed as the IC industry was also found driven by a focus on reducing defect, which allowed smaller and cheaper devices to be build and increasing the device complexity (ibid.). According to Miller and O'Leary (2007) technological roadmaps allows firms to plan and control their future capital investments on science and R&D according to future needs in the industry. Technological roadmaps are used industry-wide as a set of direction to lead this development for all actors (ibid.).

*"Technological roadmaps translate the simplified imperatives of Moore's Law into targets and time lines that individual firms can embed in their own planning and investment processes."*
*- Miller and O'Leary, 2007: 730*

According to the findings of Sanchez (2001) a modular approach to the development of new products provides several advantages such as reducing cost and time to market by developing new IP blocks rather than developing entirely new products. An important aspect of the modular approach is to have predefined interfaces to be able to combine existing and new products (Sanchez, 2001)

*"A modular product architecture is one that has been designed to allow the 'mixing and matching' of different 'plug-and-play' component variations in the overall product design to configure product variations."*
*Ron Sanchez, 2002:10*

Roadmapping is a process tool for technology planning and coordination, and, if successful, results in a technological roadmaps-document (Arden, 2002; Garcia and Bray, 1997; Gielen, 2000; MacMillen et al., 2000). Roadmaps can be done at both industry- and corporate-level. The levels require different commitments in terms of time, cost, level of effort, and complexity, but the resulting roadmaps have the same structure (Arden, 2002; Garcia and Bray, 1997; Gielen and Rutenbar, 2000; MacMillen, Butts, Camposano, Hill, and Williams, 2000).

Industry technological roadmaps involves multiple companies (Arden, 2002; Gielen and Rutenbar, 2000). By focusing on common needs, industry actors can more effectively address critical research and collaboratively develop the common technologies (Garcia and Bray, 1997). This level of technological roadmaps allows industry to collaboratively develop the key underlying technologies, rather than redundantly funding the same research and underfunding or missing other important technologies(ibid.). Hence, resources can be combined across companies, making developing the technology possible and consequently the industry more competitive (Arden, 2002; Garcia and Bray, 1997; MacMillen et al., 2000). The process behind a roadmapping is to develop, organize, and present information about system- and performance-targets in a certain timeframe, and evaluate trade-offs among different technological solutions (Garcia and Bray, 1997). Hence, roadmapping helps evaluate and develop technology to a set of product needs. To archive this, an unbiased team of industry experts is brought together to organize and present technology-planning information (Arden, 2002; Garcia and Bray, 1997). A roadmapping process identifies the critical system requirements, the product and process performance targets, and the technology options and milestones for meeting those targets (ibid.). Hence, a technological roadmaps identifies possible technology trajectories for certain performance objectives (Katila and Ahuja, 2002). A single path may be selected, but if uncertainty is high multiple paths may be selected and pursued (Garcia and Bray, 1997). According to Garcia and Bray (1997) the roadmapping process consists of three phases, depicted below in figure 4.

Garcia and Bray (1997) found that the main benefit of roadmapping is that it provides information to make better technology investment decisions by identifying critical technologies and technology gaps and identifying ways to leverage R&D investments. Hence, roadmapping is critical when the technology investment decision is not straightforward. This occurs when it is not clear which trajectory to pursue, when the technology is needed, or when there is a need to coordinate the development of multiple technologies (Garcia and Bray, 1997; Rinne, 2004).

It can be concluded that roadmapping has several potential uses and resulting benefits (Garcia and Bray, 1997; MacMillen, Butts, Camposano, Hill, and Williams, 2000; Arden, 2002).

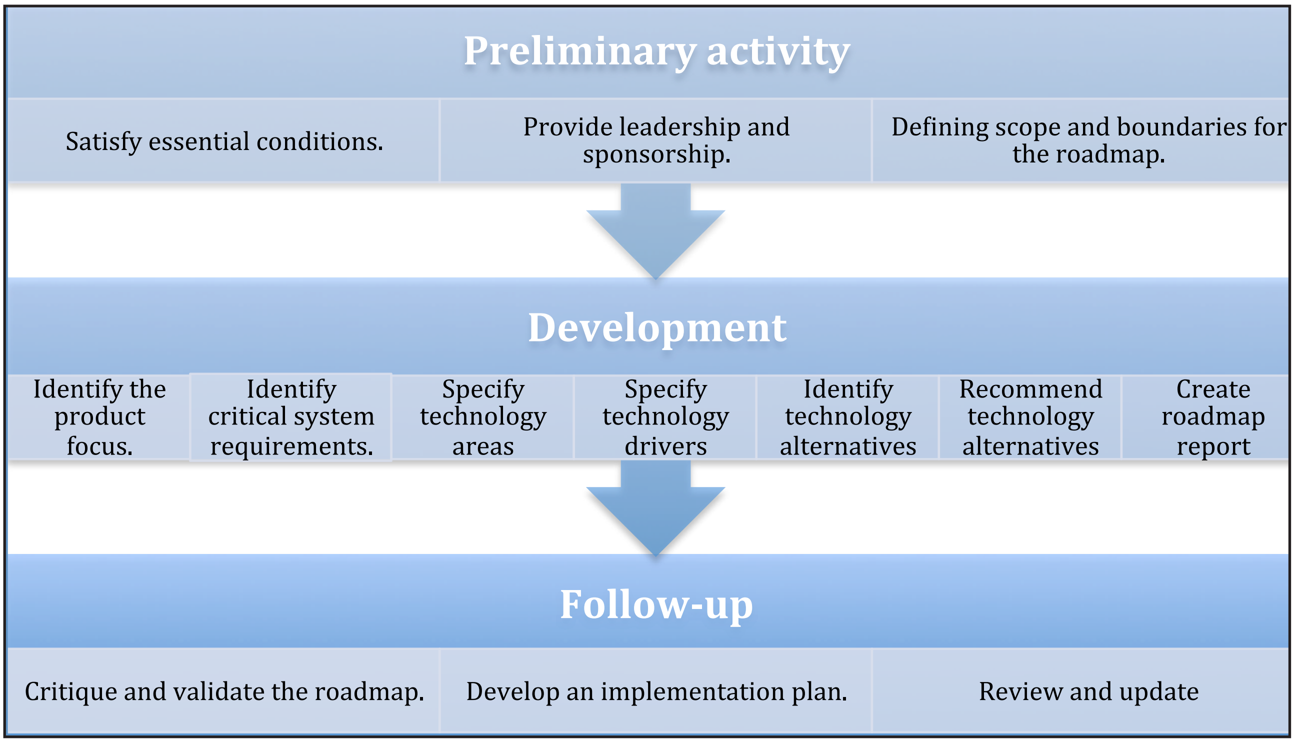


*Figure 4: The Roadmapping process. Adopted from Garcia and Bray (1997)*

Complementary to recent research on technological roadmaps, Iansiti and Levien (2004) interoduced the idea of the biological ecosystem as an analogy for understanding business networks. Acording to Iansiti and Levien (2004) certain clusters of networked companies have formed a new way to create value in the past twenty years. What have been considered differentiated industries have evolved into *Business Ecosystems.* These are characterized by a large number of loosely interconnected participants who depend on each other for their mutual effectiveness and survival (Iansiti and Levien, 2004). Every ecosystem participant will be dependent on each other's effectiveness, but also have a specialized role, as reversals in an ecosystems health can happen very quickly and all participants shares a common fate (Iansiti and Levien, 2004).

Within the business ecosystem three classes of company are described: *Keystone, Dominator,* and *Niche Player* (Iansiti and Levien, 2004). The keystone-and dominator-strategies can be pursued by firms that occupy important hubs in their business networks, and niche players spawn around them (ibid.).

A *Keystone* acts to improve the overall health of the ecosystem and, in doing so, benefits the sustained performance of the firm (Iansiti and Levien, 2004). It does this by creating and sharing value with its network by leveraging its central hub position in that network while generally occupying only a small part of that network. A *Keystone* is the center of each ecosystem, and rather than focusing primarily on internal capabilities a keystone strategy emphasize the collective properties of the business networks in which they participate, and treat these more like organic ecosystems than traditional supply chain partners (Iansiti and Levien, 2004). A *dominator*, on the other hand, acts to directly control and own a large proportion of a network, capturing most of the value created by the network and leaving little opportunity for the emergence of a meaningful ecosystem. Niche strategies can be pursued by the much larger number of firms that make up the bulk of the ecosystem. They emphasize differentiation by focusing on unique capabilities and leveraging key assets provided by others (ibid.).

Expanding their research on the trade-off between coordination and autonomy, Puranam and Srikanth (2007) analyze the paradox of post-merger integration of technology, which both enables and hampers the acquiring firm's ability to utilize the knowledge and capabilities of the acquired firm. The findings demonstrated that the integration of technological acquisitions allowed acquirers to utilized the targets existing knowledge to enriching their own innovations processes (knowledge leverage), but hampers the target firms ability to create future innovations (capability leverage) (ibid.). Knowledge leverage can be seen as exploitation of the target existing knowledge base, while capability leverage entails the exploration of new possibilities through ongoing innovation (ibid.). Thus, linking post merger integration to recognized trade-off in organizational learning (Puranam and Srikanth, 2007).

*"Managers should form clear ideas regarding whether the potential for future innovation is likely to be derived from leveraging capacity or knowledge."*
*- Puranam and Srikanth, 2007, p. 821*

The relationship between integration speed and performance is expanded upon in the following section.

### 3.2.6 The integration process

Larger acquisitions are often motivated by the need to bring products rapidly to market, as well as develop future product pipelines (Puranam, Singh, and Zollo, 2003). Puranam et al., (2003) argue that those objectives are conflicting. There is a trade-off between short and long-term performance, because acquisition integration has opposite effects on the strength of the organizational linkages between target and acquirer, and on the continued innovative capacity of the target firm (Puranam, Singh, and Zollo, 2003). Their findings suggest that organizational integration of the target firm into the acquirer's organization generates short-term disruption effects and long-term coordination benefits which, was found to distort the potential of advanced products from acquisitions of small firms (ibid.).

*"Acquiring a small firm with a product that has advanced beyond proof of concept may alleviate problems such as fear of cannibalization and lack of incentive intensity faced in internal development efforts."*
*- Puranam, Singh, and Zollo, 2003, p. 183*

Expanding on their previous research, Puranam et al., (2006) suggested that fast integration is not compatible with cycling between periods of exploration and exploitation or organizational hybrids. Instead, they suggest that synchronizing the shift in organizational emphasis with stages of technological development may avoid disrupting critical phases of exploration. Therefore acquirers should not choose between *quick* and *slow* integration strategies. Instead acquirers' should focus on an *exploration-* or *exploitation-strategy*, when selecting the structural forms of acquisitions (ibid.).

*"Acquirer must also keep in mind that the effect of choice of structural form on innovation outcomes is contingent on the stage of development of the acquired firm's innovation trajectory"*
*- Puranam, Singh, and Zollo, 2006, p. 276*

Homburg and Bucerius (2006) found integration speed to be highly beneficial for the acquisition success, in cases of high internal relatedness[1] and low external relatedness . Whereas, low internal relatedness[2] and high external relatedness, speed is deteriorating the acquisitions success (Homburg and Bucerius, 2006).

*"(…) Speed of integration exhibits a strong positive impact on M&A success in the case of low external/ high internal relatedness, while the impact is strongly negative in the opposite case."*
*- Homburg and Bucerius, 2006, s. 360.*

### 3.2.7 Comprehensive post-acquisition performance

In the following section the key findings from the six different overarching themes affecting high tech acquisitions effectiveness are listed and flowingly applied in comprehensive model, which forms the base for the analysis in this thesis:

1 Based on the relatedness of management style, strategic orientation, and pre acquisition performance.
2 Based on the relatedness of target markets, and market position.

| Theme | Key takeaways | | |
|---|---|---|---|
| **Human Capital** | Retention is important to transfer new knowledge based technologies and capabilities to the acquiring firm | Acquired leaders to create value in part by mitigating the potential conflicts between autonomy and integration | Complementary in the management team enhance value creation. |
| **Learning from experience** | Knowledge codification increases performance | Previous experience from large related M&A positively affects firm performance | Cost efficiency from integration outweighs the cost of integration |
| **Complementarity** | Complementary knowledge increases invention quality | Increasing R&D performance by acquiring the best talents with complementary science and technology knowledge | Acquisition performance is increased Through an appropriate level of similarity in technological knowledge |
| **Innovation performance** | Technological acquisitions enhance innovation performance | Innovation performance is positively affected by complementary technological and scientific knowledge | Innovative skills and competences can be acquired |
| **Technological Fit** | Technological acquisition can increase both speed and novelty of innovation effort | EDA- firms can benefit from industry wide TRs. Firms can benefit by planning and investing accordingly | TRs can increase collaboration and specialization, herby streamlining high-tech industries. |
| **The Integration Process** | Creates short-term disruption effects and long-term coordination benefits | Fast integration correlates with external and internal relatedness | Emphasize the relative importance of an exploitation- or exploration-strategy rather than fast integration speed. |

*Table 2 takeaways from the recent research*

Our pilot interviews revealed that the abovementioned topics from the literature review could be analyzed on several levels. Felin et al.'s (2012) study on the "micro foundations" of routines and capabilities provides a suitable articulation of this. Here three levels are used to analyze capabilities (as a high level of routine); Individual, Processes and Structure. The Individual level acts as an important building block for understanding organizational routines (ibid.). Thus, understanding how the actions of individuals, such as managers or engineers affect organizational performance (ibid.). In terms of *Processes* the routines and capabilities are shaped by the interactions within the organizational context provides critical insights into how these unfold (Felin et al, 2012). Moreover, in terms of integration of new technologies, learning processes are critical (ibid.). Finally, Structure affects routines and capabilities through individual and collective interactions in an organization context. Thus, enabling knowledge sharing, coordination, and integration.

As this thesis focuses on competence-based acquisitions, an understanding of how routines and capabilities are built, maintained, leveraged, and adapted these levels of analysis is very suited, and will be used to analyze six chosen topics. Hence, findings from the literature are combined into the following model, called the ETA (effective technological acquisition). The term *technological* is used to cover both human competence, as applied knowledge, and IP in the form of software, algorithms etc. The ETA model includes the six themes found in relevant academic literature, as well as the three-pronged categorization of routines and capabilities as defined by Felin et. al (2012): individuals, process and structure. The ETA model have been revised a number of times, as part of the writing process of the literature review. The alterations of the theoretically deduced model are depicted in the appendix, section 11.2, with notes of the reasons for the alterations.

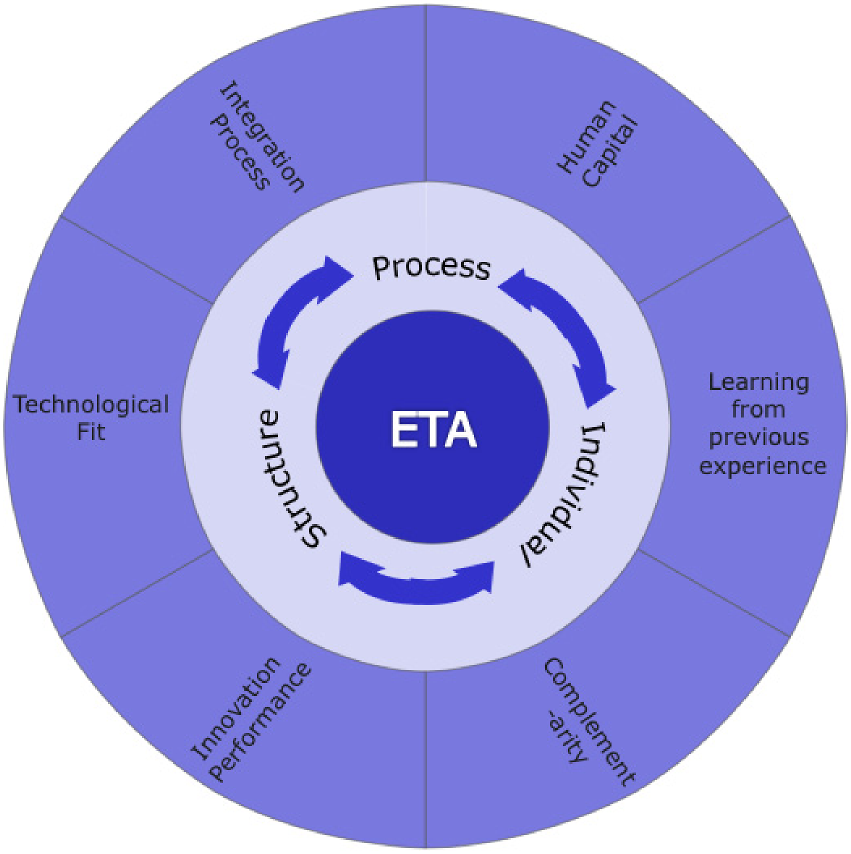


*Figure 5 Effective Technological Acquisition model, developed by authors*

# 4 Methodology

The following section outlines the methodological considerations of the thesis. This thesis follows Crewell's (2003) guidelines, and our research design will be addressed describing: (a) the research theoretical perspective, (b) the research strategies, and (c) the research methodology for data collection and analysis.

## 4.1 Research theoretical perspective

This thesis is based upon a single case study. The general purpose of the single case study method is to analyse a social event in a specified context (Yin, 2003). According to Flyvbjerg (2006) case studies provide several advantages. *First*, case studies provide research depth in terms of detail and richness in comparison to quantitative research methods (Flyvbjerg, 2006). *Secondly*, case studies ensure high conceptual validity by creating an understanding of context and process (ibid.). *Thirdly*, case studies create external validity by contributing to an understanding of what causes a phenomenon, linking causes and outcomes (ibid.). *Finally*, by fostering new hypothesizes and new research questions. However, there are also weaknesses to the use of case studies. *First,* selection bias may overstate or understate relationships (Flyvbjerg, 2006). The selection bias is sought to minimize by sampling for variance in the section of interviewees, which is expanded upon in the section on *Primary data*. *Secondly,* a weak representation of how the phenomena correlate to other phenomenon and vary across population (Flyvbjerg, 2006). This is overcome by basing the thesis on testing existing research and possibly add new elements to these, which is described in more detail in following section on *Research strategy*. *Finally,* the statistical significance is often unclear or unknown (Flyvbjerg, 2006). As this thesis is focusing on innovation through acquisitions the statistical significance is not as important, because the findings should be seen as a guideline rather than the final truth.

This thesis is based on a critical rationalism approach as it is drawing on the strength from both interpretivist and positivist paradigm (Easterby-Smith, Thorpe, and Lowe, 2004). *First*, as data collection happens through semi-structured interviews, this thesis are focusing on a relatively small sample, drawing upon an interpretivistic approach (Denzin and Lincoln, 2000; Easterby-Smith, Thorpe, and Lowe, 2004). The six interviews conducted with key employees in Synopsys are listed in table 1. *Secondly,* this thesis develops a theoretical model based on pervious research on integration of acquired firms, which is tested in practice through a case study of Synopsys Inc. in order to identify possible additions to existing research. Thus, the research position focuses on an exploratory, theory building inductive approach, to reach a conclusion based on the case study, which confirm, contradicts, and expands existing literature (Denzin and Lincoln, 2000; Easterby-Smith, Thorpe, and Lowe, 2004). *Finally,* the methodology is process oriented as the research is investigating the processual aspects of the acquisition integration process, rather than just the results (ibid.).

## 4.2 Research strategies

The analysis is based on a case study methodology, which is an exploration of a "bounded system" or a case over time through detailed, in-depth data collection, involving sources of information, which are rich in context (Yin, 2003). The case study is focused on the development of the acquisition integration process in Synopsys Inc., based on data from 46 acquisitions conducted from 1994 to 2012 (see table 5), and insights from interviews. Moreover, the case study is built upon a theory refinement and theory building approach. This thesis does not only seek to confirm existing theory, but also search for inconsistency between this thesis empirical findings and existing research in order to develop new theories (Eisenhardt and Graebner, 2007; Voss, Tsikriktsis, and Frohlich, 2002).

## 4.3 Research methodology for data collection and analysis

The data collection consists of different sources of evidence in order to ensure that the data are corroborating to the same findings (Yin, 2003). The data collection has been aimed at ensuring data triangulation, by verifying findings from case interviews using industry analysis, press releases, and industry journals (Guion, Diehl, and McDonald, 2011). The primary data collection consists of in-depth semi-structured interviews as well as observations.

The *literature review* is integrated in a conceptual model with six elements important to the integration process; in order to shed light on how high tech companies use competence-based acquisitions in innovation strategy. The interview guide is build around the six elements of the theoretically deduced ETA model, the 6 elements are; *Human Capital, Learning from Experience, Complementarity, Innovation Performance, Technological Fit, and Integration Process.* In the research guide these elements have been operationalized in the following way: In *Human Capital* the aim is to investigate how competence-based acquisitions affect *Human Capital* and how it is managed. *Learning From Experience* seeks to reveal how organizational experience with acquisitions can be used strategically. By asking interviewees if Synopsys has a way of codification acquired knowledge. Codification is important to create value, as experience accumulation does not bring any value (Zollo and Singh, 2004). *Complementarity* focuses on examining how acquisitions secure complementary technological and organizational assets by asking interviewees about why they think their firms was acquired. This question is posed in order to get their honest opinion on whether or not they have acquired complementary resources, which is found to increase R&D productivity (Cassiman et al., 2005). *Innovation Performance* emphasizes which effects acquisitions have overall innovation performance. *Innovation performance* may be increased through acquisitions by decreasing risk and time to market (Hitt, Harrison, and Ireland, 2001).

*Technological Fit* analyses how ecosystems and technological roadmaps enhance competence-based acquisitions. This is analyzed through empirical insights obtained from interviewees on how ecosystem driven technological roadmaps affect Synopsys acquisition of their firm. As technological roadmaps enables high tech firms to increase the novelty and quality of their innovations through acquisitions (Makri, Hitt, and Lane, 2010). Finally, in the I*ntegration Process* the aim of the questions posed is to identify how this influences competence-based acquisitions. The interview questions focus on how fast firms were integrated, and is used to investigate if exploration or exploitation strategies should be used instead as argued by Puranam et al., (2006).

Most of the data for this thesis has been collected directly in qualitative semi-structured interviews. McMaster (2005) defined two weaknesses of using semi-structured interviews. *First,* that results are hard to compare (McMaster, 2005). This downside is minimized by using the same interview guide for all interviews. *Secondly*, it is easy to loose control in the interview (McMaster, 2005). This risk was diminished through thorough planning of the interview situation and by acquiring basic knowledge of the business units in which the interviewees were working in (Kvale, 1996). Moreover, the interviews were initiated with briefing on the interview techniques, and ended with a debriefing (Kvale, 1996).

To increase the external validity of the interviews and to ensure a reflective approach to the knowledge sought, the interview guide has been reviewed and enhanced based on two pilot interviews conducted prior to the primary data gathering (Kvale, 1996). Based on the two pilot interviews the following adjustments were made. *First,* the interview guide and interview technique was revised to account for an experienced "misinformation effect" caused by change in memory and cognition in interviewees, since the events they were inquired about, often have happened a long time ago (Gordon and Shapiro, 2012). *Secondly,* the pilot interviews with Synopsys employees revealed that they are not used to the interview method, however the attention seemed to please the interviewees. This made the interviews easier to conduct, but made us remember the Hawthorne effect in the formulation of the interview guide.

Therefore follow-up questions were used as a control variable to ensure that their answers were consistent (Kvale, 1996). *Thirdly,* the interview process uncovered that the engineers seemed uncomfortable with the semi-constructed interviews, as soon as questions were not strictly technical. This was deemed to be a psychological and social trait of the business, but the interviewee seemed to hold back important information, once they felt insecure. This was overcome by a development in the interview methods towards interviews utilizing positive and narrative psychological intervention techniques (International Journal of Psychology, 2012; Franzoi, 2009; Bhatia, 2011). These methods proved very useful for collecting data, otherwise inaccessible via questioners or constructed interviews such as information on the strategic use of corporate and industry level roadmaps.

The secondary data consisting of reports, articles, videos and web sites, have been largely used to compare the results from the primary data to ensure a high degree of validity of the information and to investigate the acquisition history of Synopsys in detail. In the process of validating the details from the interviews the research team only encountered minor errors, such as incorrect purchase prices of acquired targets. The use secondary data have saved the researchers a lot of time during the investigation, compared to primary data collection. This is valuable in relation to the guidelines and the limitations of data. A disadvantage of using secondary data is that it might have been collected for a specific purpose contrasting the research question of this thesis (Yin, 2003). With this in mind, the secondary data has been carefully collected in order not to reflect a biased perspective (Yin, 2003).

## 4.4 Reliability, validity and limitations

The qualitative research is usually claimed to be more illustrative and representative for observed phenomena, and not seen as a general finding (Abercrombie, Hill, and Turner, 1984; Strauss and Corbin, 1998). However, Flyvbjerg (2006), Siggelkow (2007) and Stake (1995) are all arguing that persuasive power of a single case can be used to make generalizations, as they provide a rich description of a phenomenon. A case study usually contains a deeper investigation of, in this case, a firm and therefore gives a more descriptive picture of its actual problems (Flyvbjerg, 2006). Moreover, a case study can be used to either support existing theories or falsify theories (Flyvbjerg, 2006). Flyvbjerg (2006) argues that if a case study shows something else than a theory claims, this is evidence enough to prove the theory's weaknesses and misassumptions (Flyvbjerg, 2006). According to Graebner and Eisenhardt (2007) single case studies enables the creation of more complicated theories than multiple case studies, as single case allows the researcher to spend more time and effort on depth and differences. Multiple case studies focus on quantity and similarity (Graebner and Eisenhardt, 2007). Thus, single case may be effectively applied in theory development (ibid.). Based on these assumptions this thesis meets the requirements of being valid. Nevertheless, being critical to both primary and secondary sources is important (Fuglsang and Olsen, 2007).

One of the limitations to the qualitative empirical data gathering is the amount of interviews the findings of the paper is based on. However, the focus of this thesis has been to extract as much tacit knowledge from the interviews as possible, in order to confirm, contradict or extend the finding of existing research. Therefore, focus has been placed on the length of the interviews rather than the quantity, as it is time consuming to develop the needed trust relationship (Sabel, 1993). Trust is needed between the respondent and the interviewer in order to get an in-depth understanding of the problems occurring in the integration process and to get the interviewees to unfold their view of the problems, a trust relationship is need (Witzel, 2000). As, this fosters the interviewee's capability to remember and motivates self-reflection (ibid.). Moreover, to get detailed information on important events related to the integration process through confrontation, a trust relationship is needed not to induce any instantaneous justifications (Witzel, 2000). With the above considerations the next section will present the empirical data available in this thesis consisting of primary and secondary data.

## 4.5 Empirical research

In order to strengthen the external validity of the thesis both secondary and primary data has been collected. All interviews have been recorded with audio, and all mail correspondences have been saved. Moreover, the research team have copied and saved secondary data with sources if needed for investigation of the argumentation used in this thesis.

### 4.5.1 Primary data

The primary data described in table 3 is collected from managers and employees working at Synopsys. This has been collected in order to get a deeper insight and richer quality data on the post merger integration process in Synopsys. Sampling for variance is applied as a sampling technique for selecting which people to interviews. To ensure a high variance, findings are based upon different types of acquisitions, insights from different levels of the organization, as well as varying points in time. In terms of different types of acquisitions, interviews will be conducted with company 1, to get insights from small acquisitions, Comany 3 and company 4 as representative for large acquisitions. Interviews with employee 1, 2, and 3 are conducted to get information on the acquisition integration seen from a Synopsys angle at both top management level and at sales support level. Lastly, the variance in integration approach based on learning from experience is sought to be investigated by interviewing employees from different points in time, Company 2 in 1997, Company 3 in 2002 and Company 1 in 2007.

### 4.5.1 Secondary data

The secondary material is comprised of quantitative and qualitative data, primarily external data but also few internal data. First, articles such as Miller and O'Leary (2007) on mediating instruments and making markets are used to get a deeper understanding of the context. Secondly, reports are comprised of publicly available reports from established trustworthy organizations like the ITRS white thesis "more than Moore" and the Frost and Sullivan (2005) report on the EDA market. The reports are used to gain an understanding of the external environment around Synopsys. Thirdly, websites such as SYNOPSYS.ORG, NASDAQ, and WIKIVEST are used for gathering general information on Synopsys and the industry in which it operates.

| Interviewee | Acquired company | Length |
|---|---|---|
| Employee 1 (INTV 1) | Company 1 | 3 hours |
| Employee 2 (INTV 2) | Company 2 | 2 + 3 hours |
| Employee 3 (INTV 3) | VP, Synopsys native | 2 x 1,5 hour |
| Employee 4 (INTV 4) | Synopsys native | 2 hours |
| Employee 5 (INTV 5) | Synopsys native | 2 hours |
| INTV 6 | Company 3 | 3,5 hours |

*Table 3: List of Interviewees*

# 5 Synopsys, the IC, and EDA industry

The following analysis provides an overview of Synopsys and the IC and EDA industry. The first part provides an analysis of Synopsys company history, competitive environment and business portfolio. Followed by an analysis of the IC industry with focus on the evolution of the industry, and how the industry evolution formed the EDA industry. Finally, the third section will provide an analysis of all Synopsys acquisitions from 1990 to 2012.

## 5.1 Synopsys Incorporated[1]

This section introduces the case company, Synopsys, and provides an analysis of its competitive environment and product portfolio.

### 5.1.1 The Synopsys company

Synopsys was founded in 1986 by David Gregory, Dr. Aart de Geus, and a team of engineers from General Electric's (Synopsys, 2012 a). Today, the company has 6,800 employees and is the largest company in the Electronic Design Automation (EDA) industry (Nasdaq, 2013). Synopsys supply the global electronics market with software, Intellectual Property (IP), and services used in integrated circuit design, verification and manufacturing (ibid.). This is done by providing an integrated portfolio of implementation, verification, manufacturing, and field-programmable gate array (FPGA) solutions, to address key challenges to IC production, such as power and yield management, software-to-silicon verification and time-to-results (Synopsys, 2012 a). Synopsys is headquartered in Mountain View, California and has more than 80 sales, support, and R&D offices worldwide in North America, Europe, Japan, the Pacific Rim, Israel, India, Chile, and Armenia (ibid.). The largest customers of Synopsys are multinational corporations like Apple, Samsung, IBM and Toshiba (Geus, 2008).

In 2012 the company generated revenue of $ 1,756 billion or over 12% growth compared to its 2011 revenue of over $ 1,5 billion (Synopsys, 2012 b). 80 % of the total revenue comes from their backlog of committed orders (ibid.). Synopsys has identified this recurring revenue stream from licensing agreements, as one of the main reason for their revenue and market growth despite the financial crisis (ibid.). Thus, implying that Synopsys relaying heavily on their customers to renew their licenses of their software to stay in business.

Synopsys plays an essential and very specialized role in the IC-industry, by providing software and design that allows the customers to design and manufacture advanced microchips. Hereby Synopsys focus on EDA and related technologies, while relying on other industry players to perform other critical part in order to drive the industry.

As many other high tech companies a large part of the revenue is reinvested in R&D to maintain their competitive edge. Synopsys used 33,12 % or $581.6 million of the total revenue in 2012 on R&D expenditures (Synopsys, 2012 b). The following section analyses the main competitors of Synopsys and their growth strategies.

### 5.1.2 Competitors

Within the EDA Industry, Mentor Graphics and Cadence are identified as the main competitors (Synopsys Annual report, 2011). Complementary products such as customers own designs tools and

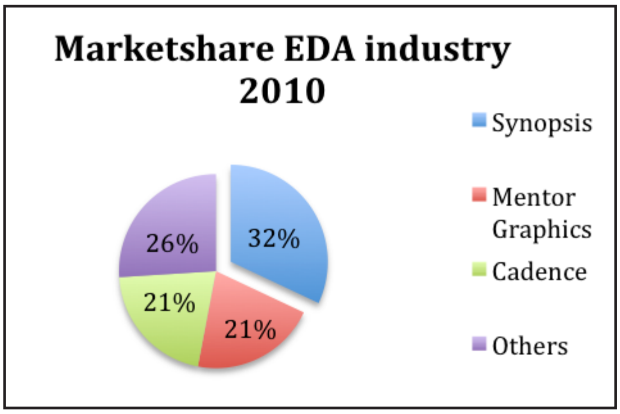


*Figure 6 based on figures from Gary Smith (2010)*

1 If nothing else is mentioned, the information in this section is derived for the 2012 Annual Report of Synopsys Inc.

internal design capabilities also act as competitive forces (ibid.).

Synopsys is the market leader with 11% points larger market share than its closest competitors, which is apparent in Figure 6. Synopsys has managed to utilize the financial crisis to increase their competitive position in the industry, and become a market leader (Gary Smith , 2011).

Cadence is the only competitor following a strategy of growth through acquisitions as Synopsys, and had a focus on creating a coherent complementary product portfolio covering all aspects of the design process (INTV 6, 2013). Compared to Synopsys, Cadence has a stronger market presence in analog design tools and are increasing their portfolio into digital design tools (ibid.).

*"Cadence has been more flamboyant, and has a willingness to use more money in acquisitions or entertaining their customers."*
*- INTV 6 (2013)*

However, one of the reasons for Cadence's not having a higher market share is its management turnover resulting in strategic fluctuations, but this creates a more dynamic firm (INTV 6, 2013; INTV 6, 2013). This is contrary to the very stable, but risk averse, top management in Synopsys (INTV 6, 2013). However, Cadence has been able to maintain higher growth rates in the recent year (INTV 6, 2013)

*"Cadence has in the last two year not done nearly as many acquisitions as we, growing actually faster than us."*
*- INTV 6 (2013)*

Mentor Graphics has a blue ocean-inspirited strategy resulting in the creations of its many point tools, rather than the more coherent portfolios of Cadence and Synopsys (INTV 6, 2013).

*"Mentor is not focusing on synergies across their product portfolio. They have a much more fragmented customer base compared to Cadence and us. "*
*- INTV 2 (2013)*

Mentor Graphic has focused on organic growth rather than growth through acquisitions, as Synopsys and Cadence (INTV 6, 2013).

*"Mentor Graphics do not compete head to head with either us or Cadence."*
*-INTV 3 (2013)*

In the following section the company's products and services are listed and their importance is depicted by their percentage of total revenue.

## 5.1.3 Products and services

The products and services are categorized into four different groups for management accounting purposes (Synopsys, 2012 c):

1. Core EDA
2. Intellectual Property and System-Level Solutions
3. Manufacturing Solutions
4. Professional Services

### 5.1.3.1 The core EDA business

Synopsys's core business consists of the Galaxy Design Platform, Discovery Verification Platform, and FPGA design. The Galaxy Design Platform is used to develop cell based and custom IC designs, it consists of a full suite of tools enabling design for the 20nm node and smaller (Synopsys, 2013 b).

The Discovery Verification Platform consists of an integrated portfolio of functional, analog/mixed-signal, formal and low-power verification products (Synopsys, 2013 c).

The FPGA design encompasses FPGA prototyping, implementation, and de-bugging tools. FPGAs are complex chips that can be customized or programmed to perform a specific function after they are manufactured (Synopsys, 2013 c). The core EDA accounted for $1,08872 billion or 62 % of the total revenue in 2012 (Synopsys, 2012 b).

#### 5.1.3.2 Intellectual Property and system-level solutions

Synopsys has a broad range of IP solutions for SoC (System on a chips) design in its Designware® portfolio, including infrastructure, verification, and memory IP such as industry wide interfaces; USB, DDR, HDMI, SATA and PCI Express. The system level solutions include a wide range of tool for verification and prototyping. The Intellectual Property and System-Level Solutions accounted for $439 million or 25% of the total revenue in 2012 (Synopsys, 2012 b).

#### 5.1.3.3 Manufacturing solutions

Includes products and technologies use to design IC layout, yield enhancements and modeling of physical effects within the ICs. Manufacturing Solutions accounted for $ 175.6 million or 10 % of the total revenue in 2012 (Synopsys, 2012 b).

#### 5.1.3.4 Professional services

Provides a broad portfolio of consulting and design services in all phases of the SoC development phase. Professional Services accounted for 52,68 million or 3% of the total revenue in 2012 (Synopsys, 2012 b).

### 5.1.4 Summarizing Synopsys inc.

Based on the analysis Synopsys is found to spread it revenues over a diverse portfolio covering the complete SoC design process. One of the drivers for the expansions of the products has been the high level of revenues the firm reinvests in R&D and the strategy of growth through acquisitions. Compared to its competitors Synopsys has been able to maintain a steady growth rate partly due to its stable top management.

In the following section the interdependencies and development of the IC and EDA industry is analyzed.

## 5.2 The EDA Industry

This provides an introduction to the IC, and EDA industry. Moreover, it provides an analysis of the evolution of the industry. Lastly, it provides an analysis of the structures, IP and innovation in the EDA industry.

### 5.2.1 Introducing the IC- and EDA-industry

The Integrated Circuit (IC) is the latest and most effective form of electronic circuits that have evolved from electric circuits and enable modern electronic informatics (Veendrick, 2011). ICs has many uses in electronics, and can be customized to fit various needs, but is most commonly found as amplifiers, oscillators, timers, counters, memory or microprocessors (ibid.). This makes ICs the central component of all advanced electronic equipment for both consumers and professionals.

The Electronic Design Automation (EDA) industry is a particular sub-industry of the IC industry and focuses on computer aided chip design. The IC industry is hardware based and focused on manufacturing while the EDA industry develops software to assist the design and testing of ICs.

The EDA industry has a very clearly defined structure and a number of small firms are active in the industry, which are frequently acquired by larger industry players (Macmillen et al., 2000; WIKIVEST, 2007; INTV 6, 2013). The EDA industry covers a number of complex processes from chip design through to testing, and this can be divided into a number of segments which focus on special aspects of the processes of designing and testing (Macmillen et al., 2000 ; INTV 6, 2013).

The development in IC design has allowed companies to disintegrate their design value chain and made geographical dispersion viable due to vertical specialization. This created several multi-layered Global Design Networks (GDNs) (Ernst, 2006; Gawer and Cusumano, 2002).

There are three distinguishable layers in the GDNs, see Figure 5: *First*, the core consists of five different types of firms (IC industry); a system company defining the concept, an integrated global IC company, or a fabless (see technical glossory p. 115) design house or a combination of these may do the design of the chips (ibid.).

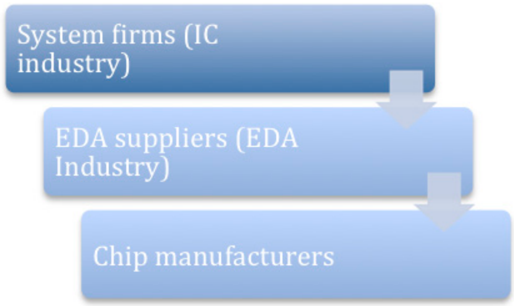


*Figure 7 GDNs in the IC industry*

*Secondly,* suppliers of EDA verification, chip testing and design implementation services (ibid.). Finally, the last layer consists of system contract manufacturers producing the actual chips (ibid.).

The IC industry is continuously developing, and this carries heavy investments and great technological uncertainty. With the progressive externalization of production tools to the suppliers of specialized equipment, the need arose for a clear roadmap to anticipate the evolution of the market and to plan and control the technological needs of IC production (Arden, 2002; Miller and O'Leary, 2007). Technological roadmaps are used industry-wide as a set of direction to lead this development for all actors (Arden, 2002; Miller and O'Leary, 2007). It provides the information needed to make trade-offs among different technology alternatives (Garcia and Bray, 1997). Thus, technological roadmaps coordinate technological and financial trajectories. This strengthens innovation by linking the market with the challenges of technological barriers and facilitates some sharing of knowledge and collaboration between stakeholders (Miller and O'Leary, 2007). The strategic importance of technological roadmaps is expanded upon in the analysis of *Technological fit,* section 7.5.

### 5.2.2 How the development of the IC Industry has formed the EDA industry

The evolution of ICs have been fast paces and characterized by heavy competition and investment (Macmillen et al., 2000). Gordon Moore, co-founder of the Intel Corporation, made an observation that the number of transistors per square inch on a microprocessor chip grows exponentially, doubling approximately every two years (Miller and O'Leary, 2007; INTV 6, 2013). This prediction was later named Moore's law and has become something of a self-fulfilling prophecy as manufacturers competed in developing faster, smaller and cheaper electronic devices (ibid.). Low cost production of IC's has made computers, mobile phones and other digital home appliances an integrated part of structure in modern societies today (Macmillen et al.,2000). Even though Moore's Law was initially put forth in 1965, it is still followed as a guideline for the whole industry (ibid.).

*"Even through Moore's predictions were initially made about specific kind of ICs, the microprocessors, today it is followed as a general guideline the industry" -INTV 3 (2013)*

The first electronic circuits were made by hand, but circuits' size and requirements in production precision soon dictated a transition to electronic fabrication. IC design has traditionally been done partial manually with all kinds of circuits. This has been a classical engineering discipline with application of advanced physics and mathematics (ibid.). Both the fast industry development, and the reliance of mechanized production, has also given options to streamline the designing process with computer aid (ibid.). The modern IC design process is very advanced in terms of methodology, and use a broad range of computer scientific tools for computer aided designing and manufacturing (Macmillen et al., 2000). EDA is the software tools for designing ICs. These tools work together in a design flow that chip designers use to design and analyze entire IC chips (MacMillen et al., 2000). In the table on the following page the development of IC industry from 1958 to 2000 is analyzed.

| Decade | Development |
|---|---|
| 1958-70 | The IC industry is started by J. Kilby's invention of the first IC. This leads to scientific breakthroughs in the appliance of Boolean algebra, studies in combinational logic circuits. Moore makes his prediction in 1965 (Jiand and Devadas, 2008). Production, design, and testing are all done by hand (Jiand and Devadas, 2008; MacMillen et al., 2000). |
| 1070-80 | Production starts to digitalize and digital testing and simulations is introduced with graphical user interfaces (GUI). This development virtualize the design process, without actual soldering or coding, and can even test and improve in a simulated logic-level environments (Jiand and Devadas, 2008; MacMillen et al., 2000). The Increasingly spread of IC usage and ever-increasing complexity, coupled with a scarcity of qualified IC engineers, created a need for software that could streamline the development process (MacMillen et al., 2000). As a result IC developers began to use computer-aided design (CAD), the first generation of EDA tools. |
| 1980-90 | As both applied broadness and internal processing effectiveness in ICs rapidly increased, GUI-powered design tools improved. This results in software-industry features enabling synchronized automatic placement and routing, design rule check, layout versus schematic comparison. This period also brought the US government subsidized hardware description languages Verilog and VHDL (MacMillen et al., 2000). Based on these languages, toolsets known as computer-aided engineering (CAE) were build. This was a great progress in automating the design of complex integrated circuits, but was still heavily dependent on engineers to do manual labor in the process (MacMillen et al., 2000). Therefore CAE could not keep up with the fast-paced changes of the electronics industry, and increasing circuit complexity led to an opening for a third generation design method in the 1980s; logic synthesis, which marked Synopsys entry to the market (Jiand and Devadas, 2008). In 1987 Synopsys first commercial logic synthesis products were launched (ibid.). |
| 1990-00 | Synthesis from RTL descriptions becomes the industry standard designing method. The EDA market for ICs has grown to approximately $3B and there have been significant amount of acquisitions, resulting in fewer and larger firms operating in the industry (Jiand and Devadas, 2008; MacMillen et al., 2000). Synopsys used this period to expand the offerings within their core offering, verification, with 8 acquisitions of companies with complementary technologies and technical capabilities, and expanded their core business with complementary IP and systems portfolio based on the acquisitions of CADIS and silicon Architects (Synopsys, 2012 a). Furthermore, with acquisition of Smartech, Synopsys expanded it offerings to also cover the increasing need for consultancy and formed the professional services business area (INTV 6, 2013). |

*Table 4 development of IC industry from 1958 to 2000*

### 5.2.3 Structure, intellectual property and innovation in the EDA industry

The EDA industry has a unique structure (INTV 3, 2013; Garcia and Bray, 1997; MacMillen et al., 2000). The development in the industry seems to renew technology, and hereby incorporate technology decline without the need to replace industry actors (ibid.). IPR appears to enhance this effect, since it protects investments. Furthermore, IPR facilitates a structure of modular design, where technology is reused in IP blocks (ibid.).

One of the distinct features of the EDA industry is that most of the new chips contain existing components (Estave, 2011). Thus, Synopsys and the rest of the EDA industry is mostly concerned with incremental innovation (INTV 6, 2013; Estave, 2011; MacMillen et al., 2000). The different components used in the development of chip sets are defined as "IP blocks", as these components and their functionality are protected by intellectual property rights (IP) (Birnbaum, 2004). These IP blocks are used in modular product architecture, which enables parallel development of modules (IP blocks) without the need to coordinate such development (Sanchez, 2002; Ernst, 2006). Reusing IP blocks decrease the time to market and reduces the risk; this can be done either by utilizing the internally developed functionalities or by purchasing third party IP blocks (Kunkel, 2012; Birnbaum, 2004). The standardized interfaces on chips for mounting IP blocks makes it easier for companies to incorporate 3rd part IP blocks into their chips, making it possible for these companies to benefit from these high quality components (Kunkel, 2012). This is a clear example of one of the advantages of applying modular design in the development of new chips, as the time to market can be reduced because of predefined interfaces between the IP blocks and chips (Sanchez, 2002).

The EDA industry is moving fast and due to the modular structure of the design process; time to market is significantly reduced (Kunkel, 2012; Birnbaum, 2004). To cope with the increasing complexity and demand for reduce in time to market from consumers, smaller IP blocks are being bundled into bigger functional IP blocks (Kunkel, 2012; Birnbaum, 2004). Thus, combining existing technologies to create incremental process and product innovation, while coordinating commentary innovations, and utilizing their expertise to develop tools to effectiveness of the development process (Hitt et al., 2001).

The competition within the EDA industry is fierce; with empathize on increasing market share through price reductions, or use bundling of software as a long-term strategy to try and force competitors out of the market (WIKIVEST, 2007; INTV 6, 2013). Due to the fast development phase of new chips, EDA software need to be upgraded or redesigned every second year ( INTV 6, 2013). Thus, increasing the competition even more, as the sales period for the software is short (ibid.)

Due to the rapid development speed, fostered by the modular architecture, the need for evaluating the cost of protecting chips set increases, as many of these will be obsolete in a year after they are introduced according to the technological roadmaps (ITRS, 2010). However, the IC companies are protecting their chips due to the high development costs they incurred, and because of the incremental nature of the industry their combination of the IP blocks is what differentiates their chip from competitors (Kunkel, 2012; INTV 6, 2013).

Furthermore, all players on the market are focusing on reducing cost in order to boost their profits (Frost and Sullivan, 2005). As another strategic move companies cut back on production, but invest in tools and engineering capabilities so that they have new and innovative products ready for future demand (Morris, 2012). Due to these large investments the threat from new entrants is significantly reduced, as they have to make large investments to enter the industry (Morris, 2012).

Thus, companies like Synopsys may have the competences to incorporate innovations from other industry players in their own processes, which reduce cycle time leading to a fall in the development costs (INTV 6, 2013; Hitt et al.,

2001). In the analysis of *Innovation performance*, the strategic importance of this ability will be elaborated upon.
Moreover their strategic focus is on cutting costs and at the same time investing heavily in R&D to strengthening their competitive position, keeping new competitors out of the market and it sends a strong signal to existing competitors of the firm's competitive strategy (INTV 6, 2013).

### 5.2.4 Summarizing the EDA industry

From the analysis it can be deducted that Synopsys is operating within the EDA industry, a Sub-industry of the IC industry. Technological roadmaps were found to play a significant role in shaping the industry dynamics, as they are used industry-wide as a set of direction to lead this development for all actors. Thus, industry level technological roadmaps was found to coordinate technological and financial trajectories. Companies like Synopsys were found to have the ability to integrate acquired competences into their existing solutions.

Modularizing with IP is found to be key to efficient innovation in the EDA industry, and IP facilitates investments in technology by providing investment security. New product development is based on modular design with a high degree of reused IP blocks, which reduces the production costs, development time, and risk as the components on the final product are reused.

Thus, companies like Synopsys have the competences to incorporate innovations from other industry players in their own processes, which reduce cycle time leading to a fall in the development costs. Moreover, their strategic focus is on cutting costs and at the same time investing heavily in R&D to strengthen their competitive position, keeping new competitors out of the market and it sends a strong signal to existing competitors of the firm's competitive strategy.

## 5.3 EDA industry level technology roadmapping

Constructing integrated circuits, or any IC device, requires a series of operations - photolithography, etching, metal deposition, and so on. As the industry has evolved, each of these operations was typically performed by specialized commercial companies. This specialization may potentially make it difficult for the industry to advance, since in many cases it does no good for one company to introduce a new product if the other needed steps are not available around the same time (Arden, 2002). Technology Roadmaps are uesd to provide direction when certain capability are needed. Then suppliers can target this direction for their piece of the puzzle (Arden, 2002; Miller and O'Leary, 2007).

Commercial industry actors provides a set of needs, and the technology road mapping process provides a way to develop, organize, and present information about the critical system requirements and performance targets that must be satisfied by certain time frames (Rinne, 2004; Miller and O'Leary, 2007; Garcia and Bray, 1997). Furthermore, it identifies technologies that need to be developed to meet those targets (ibid.).

In the EDA industry technology roadmaps facilitates development by setting clear direction and purpose (Kleer and Wagner, 2012). Recent research has shown this to be very relevant in IC development (Miller and O'Leary, 2007). The EDA industry is dependent on collaboration with actors in the other layers of the industry, and herby technology roadmaps provide a framework for collaboration between players (Rinne, 2004; Miller and O'Leary, 2007; Garcia and Bray, 1997). This is done by having overall industry development plans; firms can incorporate into individual targets, time lines, and investments (Miller and O'Leary, 2007). Thus, technological roadmaps coordinate technological and financial trajectories. This strengthens innovation by linking the market with the challenges of technological barriers and facilitates some sharing of knowledge and collaboration between stakeholders (Miller and O'Leary, 2007).

The EDA Road mapping process is facilitated by the IC Industry Association (SIA) in the IC Technology Roadmap (Stechnological roadmaps) and International Technology Roadmap for ICs (Itechnological roadmapsS) (Arden, 2002; MacMillen et al., 2000). Both roadmaps is a set of documents produced by a group of representative IC industry experts, and are sponsored by organizations which include various IC industry organizations from the US, Europe, Japan, South Korea, Taiwan and 936 companies which are affiliated with the ITRS. The Roadmaps gives direction of research and time-lines up to 15 years (Arden, 2002; http://www.itrs.net).

For Synopsys the industry level roadmaps provide valuable information used to identify possible targets based on the industry needs, and the direction in which it develops (Miller and O'Leary, 2007; INTV 6, 2013). Moreover, the industry wide roadmaps provide Synopsys with vital information about customers to ensure that they maintain the customer driven approach to R&D (INTV 6, 2013).

## 5.4 Analysis of the Synopsys Acquisition history

For companies like Synopsys, who are competing on technological leadership, acquisitions are commonly used by the main players in the industry to decrease the time to market and in order to maintain their position in the market (Kleer and Wagner, 2012). Synopsys is using acquisitions to get access to new breakthrough technologies, key employees and getting control of important IP rights (Kleer and Wagner, 2012; Synopsys, 2012 b). Thus acquisitions play an important role in the company's growth strategy.

The following section (table 5) provides an analysis of the Synopsys acquisitions, from 1994 to 2012, listed in the table below. The analysis is based on two factors. Haspeslagh and Jemison's (1991) distinctions of different types of acquisitions are analyzed:

- Domain Strengthening,
- Domain Extension
- Domain Exploration.

In order to identify which types of acquisitions Synopsys are conducting, and witch tools they apply to transfer capabilities, this is followed by an analysis of the types of Strategic Capability Transfer;

- Operational Resource Sharing
- Transfer of Functional Skills
- Transfer of General Management Skills
- Combination Benefits

| Year | Company acquired | IP and Systems | Implementation | Verification | Manufacturing | Services | Domain Strengthening | Domain Extension | Domain Exploration | Operational Resource Sharing | Transfer of Functional Skills | Transfer of General Management Skills | Combination Benefits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Only tech assets, not company acquisitions | **Product Portfolio** | | | | | **Type of acquisition** | | | **Type of Strategic Capability Transfer** | | | |
| 2012 | **Springsoft Inc.** | | | X | | | | X | | X | X | X | X |
| | Notes | | | | | | Complements Synopsys' verification portfolio | | | Increasing local engineering expertise, technology development capabilities and customer support | | | |
| 2012 | **MoSys*** | X | | | | | | X | | | X | | |
| | Notes | | | | | | Added SerDes IP to Designware® IP portfolio | | | Through the integration of mixed-signal designers to the existing Designware® team. | | | |
| 2012 | **Inventure Inc.** | X | | | | | | X | | X | X | | |
| | Notes | | | | | | Accelerate the development of interface IP such as USB, MIPI and HDMI. | | | Interface IP and talented engineering team enables Synopsys to collaborate more deeply with the local IC industry | | | |
| 2012 | **EVE SA** | | | X | | | | X | | X | X | X | |
| | Notes | | | | | | Extended the verification platform by adding emulation tools | | | Transfer of emulation capabilities to verification R&D through the integration of EVE R&D engineers | | | |
| 2012 | **Mask Synthesis Tech.* from Luminescent** | | | | X | | | X | | | X | | |
| | Notes | | | | | | By strengthening Synopsys' mask synthesis portfolio. | | | The effective transfer and integration of technological capabilities of the acquired human capital enhances the offering of 20nm and below silicon technologies | | | |

*Table 5 Synopsys Acqusition History*
*Sources: Based on information from Synopsys investor relations, SEC 10-K and 10Q forms 1994-2012, EE Times website, investigating.businessweek.com, Kleer and Wagner (2012),*

*See appendix for an extended description of the acquisition*

| Year | Company acquired | IP and Systems | Implementation | Verification | Manufacturing | Services | Domain Strengthening | Domain Extension | Domain Exploration | Operational Resource Sharing | Transfer of Functional Skills | Transfer of General Management Skills | Combination Benefits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Only tech assets, not company acquisitions | **Product Portfolio** | | | | | **Type of acquisition** | | | **Type of Strategic Capability Transfer** | | | |
| 2012 | **RSoft Inc.** | | | | X | | | X | | | X | | X |
| | Notes | | | | | | RSoft's photonics design and simulation software extends Synopsys' platform | | | Extending offering into other photonic areas such as optical waveguide modeling | | | |
| 2012 | **Ciranova Inc.** | | X | | | | | X | | X | X | X | X |
| | Notes | | | | | | Added technology to accelerate advancements in its custom integrated circuit (IC) design solutions | | | Added experienced engineering talents capable of reducing time and effort needed to develop transistor-level layout on advanced nodes | | | |
| 2012 | **Magma® Design Automation Inc.** | | X | | | | X | | | X | X | X | X |
| | Notes | | | | | | Small effect on performance due to the high relatedness of product portfolios | | | Transferring functional capabilities Through the integration of Magma's R&D engineers and senior management team. | | | |
| 2012 | **ExpertIO Inc.** | | | X | | | | X | | X | X | | |
| | Notes | | | | | | Added Verification IP for industry standard protocols | | | Addition of ExpertIO's protocol experts, along with CEO Craig Stoops, and its strong portfolio of storage VIP | | | |
| 2011 | **Extreme DA** | | | X | | | | X | | X | X | | |
| | Notes | | | | | | Added Complementary statistical static timing analysis (SSTA) tool | | | Increased the technical support team for mobile devices | | | |
| 2011 | **nSys Ltd.** | | | X | | | | X | | | X | | |
| | Notes | | | | | | Expanded verification portfolio and added more Verification IP to the DesignWare IP portfolio | | | New protocol compliance test-suite product line. And verification methodologies. As well as adding verification engineering talents including Atul Bhatia | | | |
| 2010 | **VaST Systems Technology Corporation** | | | | X | | | X | | X | X | X | X |
| | Notes | | | | | | Extension of the position in the adjacent photonics industry | | | Added IC lithography equipment and cameras. Increased the market position in photonics | | | |
| 2010 | **Virage Logics Inc.** | X | | | | | | X | | X | X | X | X |
| | Notes | | | | | | Added extensive IP portfolio for interface and analog IP | | | Extends the IP development team by adding experienced talents | | | |

| Year | Company acquired | IP and Systems | Implementation | Verification | Manufacturing | Services | Domain Strengthening | Domain Extension | Domain Exploration | Operational Resource Sharing | Transfer of Functional Skills | Transfer of General Management Skills | Combination Benefits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Only tech assets, not company acquisitions | | **Product Portfolio** | | | | | **Type of acquisition** | | | **Type of Strategic Capability Transfer** | | | |
| 2010 | **Optical Research Associates** | X | | | | | | | X | | | | |
| | Notes | | | | | | Expansion into adjacent photonics market | | | Firm keep intact, as it has a high brand value in the market, and Synopsys does not. | | | |
| 2010 | **Nusym Inc.** | | | X | | | | X | | X | X | | |
| | Notes | | | | | | | | | Added software for verification closure solutions for electronic products manufacturing companies to its manufacturing solutions. | | | |
| 2010 | **ZeroSoft, Inc.** | | | X | | | | X | | X | X | | |
| | Notes | | | | | | | | | Added software technology for logic verification of complex, IC designs to the verifications portfolio | | | |
| 2010 | **TeraRoute LLC** | | X | | | | | X | | | X | | |
| | Notes | | | | | | | | | Added the T route product to the implementation portfolio | | | |
| 2009 | **Gemini Design Technology** | | X | | | | | X | | X | X | | |
| | Notes | | | | | | | | | Strengthen the Hspice technology and added experience talents such as Dr. Baolin Yang and dr. Zhang | | | |
| 2009 | **Analog Business Group of MIPS Technologies** | X | | | | | | X | | | X | | |
| | Notes | | | | | | | | | Expanded the DesignWare® analog IP portfolio by adding a new string of analog IPs and highly skilled IP Engineering Team further reducing risk and time-to-market | | | |
| 2008 | **Synplicity Inc.** | X | | | | | | X | | X | X | X | X |
| | Notes | | | | | | Provided a new product portfolio of innovative of FPGAs, IC design and verification solutions | | | Added a new FPGA Business Unit expanding the product offering | | | |
| 2007 | **ArchPro Design Automation, Inc.** | | | X | | | | X | | X | X | X | |
| | Notes | | | | | | | | | Addition of complementary power management technologies to the verification platform including specialized engineering talents | | | |

| Year | Company acquired | IP and Systems | Implementation | Verification | Manufacturing | Services | Domain Strengthening | Domain Extension | Domain Exploration | Operational Resource Sharing | Transfer of Functional Skills | Transfer of General Management Skills | Combination Benefits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Only tech assets, not company acquisitions | **Product Portfolio** | | | | | **Type of acquisition** | | | **Type of Strategic Capability Transfer** | | | |
| 2007 | **Sandwork Design Inc.** | | | X | | | | X | | | X | | |
| | Notes | | | | | | | | | Added complex analog and mixed signal SoC debugging and analytical tools to the existing Diversity verification platform. And added experienced verification engineers. | | | |
| 2006 | **Sigma-C AG** | | | | X | | | X | | X | X | X | |
| | Notes | | | | | | Added optical lithography simulation software | | | The acquisition of the Munich-based Sigma-C adds roughly 50 employees and a microlithography simulator | | | |
| 2006 | **Virtio Corporation Inc.** | X | | | | | | X | | X | X | | |
| | Notes | | | | | | | | | Expanded the Synopsys system studio Through the addition of virtual platforms for embedded software development. | | | |
| 2005 | **HPL Technologies, Inc.** | | | | X | | | X | | X | X | X | |
| | Notes | | | | | | Added IC IP, data analysis platforms, factory floor systems. | | | Added employees to the professional service division | | | |
| 2005 | **TriCN Inc.*** | X | | | | | | X | | | | | |
| | Notes | | | | | | Added a string of Interface-Specific I/Os (ISI/O) and SerDes IP core to the DesignWare® interface IP portfolio | | | Pure technology transfer as TriCN filed for bankruptcy. Thus, no capability transfer. | | | |
| 2005 | **Nassda Corporation Inc.** | | | X | | | | X | | X | X | X | X |
| | Notes | | | | | | Added full-chip circuit verification software for complex nanometer ICs | | | Adding strong engineering talent to the verification team | | | |
| 2004 | **Leda Design Inc.** | | | X | | | | X | | X | X | X | |
| | Notes | | | | | | | | | Expanded the DesignWare® IP portfolio as well as Increasing the IP engineering team with a the 80-person engineering and support team of a developer of mixed- signal IP | | | |

| Year | Company acquired | IP and Systems | Implementation | Verification | Manufacturing | Services | Domain Strengthening | Domain Extension | Domain Exploration | Operational Resource Sharing | Transfer of Functional Skills | Transfer of General Management Skills | Combination Benefits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Only tech assets, not company acquisitions | Product Portfolio | | | | | Type of acquisition | | | Type of Strategic Capability Transfer | | | |
| 2004 | **Accelerant Networks Inc.** | X | | | | | | X | | X | X | X | |
| | Notes | | | | | | Expanded infrastructure IP portfolio to provide a full offering of standards-based and chip infrastructure IP. | | | Added 20 experienced IP engineers along with the expansion of the Synopsys Designware IP portfolio. | | | |
| 2004 | **Cascade IC Solutions, Inc.** | X | | | | | | X | | X | X | X | |
| | Notes | | | | | | Completed the interface IP portfolio PCI Express string with digital logic IP solutions, PCI Express, and digital IP solutions. | | | Extended the IP portfolio and added 10 engineering experts in PCI express to drive the further development of the technology. | | | |
| 2004 | **ADA Inc.** | | X | | | | | | | X | X | X | X |
| | Notes | | | | | | Extended the analog and mixed-signal offerings of Synopsys | | | Added ADA's analog and mixed-signal tools and technology, and will hire its technical, applications and sales team. | | | |
| 2003 | **InnoLogic Systems, Inc.** | | | X | | | | X | | X | X | X | |
| | Notes | | | | | | Added complementary verification tool for silicon chips | | | Expanded its professional services with research and verification service consultancy to firms using silicon in their products. | | | |
| 2003 | **Qualis Verification IP** | | | X | | | | X | | X | X | X | |
| | Notes | | | | | | Added Domain Verification Component (DVCTM) technology into the Verification IP | | | Added verification methodology consulting and training services by retaining key Qualis staff, Janick Bergeron, CTO and expert for verification methodology | | | |
| 2003 | **Numerical Technologies Inc.** | | | | X | | | X | | X | X | X | |
| | Notes | | | | | | Added sub wavelength lithography solutions to complement existing design for manufacturing solutions. | | | Increasing the manufacturing R&D team with capabilities within sub-wavelength chips production optimization. | | | |

| Year | Company acquired | IP and Systems | Implementation | Verification | Manufacturing | Services | Domain Strengthening | Domain Extension | Domain Exploration | Operational Resource Sharing | Transfer of functional Skills | Transfer of General Management Skills | Combination Benefits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Only tech assets, not company acquisitions | Product Portfolio | | | | | Type of acquisition | | | Type of Strategic Capability Transfer | | | |
| 2002 | **Co-Design Automation Inc.** | | | X | | | | X | | X | X | X | |
| | Notes | | | | | | Enabled the development of state-of-the-art design language services | | | Added engineering experts to be able to develop next generation hardware language verification technology. | | | |
| 2002 | **inSilicon Inc.** | X | | | | | | X | | X | X | X | |
| | | | | | | | Expansion of the interface IP portfolio by adding standards-based connectivity IP | | | This new team enables us to more quickly deliver high-quality cores for emerging connectivity standards such as USB On-the-Go. | | | |
| 2002 | **Avant! Inc.** | | X | | | | | X | | X | X | X | X |
| | Notes | | | | | | Added proven, advanced physical design technology that complements Synopsys Physical Synthesis products. | | | Completion of Synopsys portfolio of physical design and verification products. As well as strengthen the Synthesis R&D team and added strong talents to the sales staff. | | | |
| 2001 | **C Level Design* Inc.** | X | | | | | | X | | | X | | |
| | Notes | | | | | | Integration of their CycleC into the existing VCS simulator | | | Acquisition of the technological assets accelerating VCS simulations. | | | |
| 2000 | **The Silicon Group Inc.** | | | | | X | | X | | X | X | X | |
| | | | | | | | Primarily acquired to gain access to and implement their existing turnkey design services | | | Added consultants with expertise in the entire design process, to the professional services expanding their offering with design services | | | |
| 2000 | **Leda SA** | X | | | | | | X | | X | X | X | |
| | Notes | | | | | | Provided Synopsys with complementary tools, e.g. rule checkers for VHDL and Verilog | | | Moreover the acquisition added consultancy and services in customer-specific EDA tool development. | | | |

| Year | Company acquired | IP and Systems | Implementation | Verification | Manufacturing | Services | Domain Strengthening | Domain Extension | Domain Exploration | Operational Resource Sharing | Transfer of Functional Skills | Transfer of General Management Skills | Combination Benefits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Only tech assets, not company acquisitions | Product Portfolio | | | | | Type of acquisition | | | Type of Strategic Capability Transfer | | | |
| 2000 | **VirSim tool* from Innovada Inc.** | | | X | | | | X | | X | X | X | |
| | Notes | 2nd Acquisition of assets steaming from the former ViewLogic Inc. | | | | | Added complementary technology already used in Synopsys tools as well as a development team to the verification business | | | Acquisition of supplier as the VirSim's technology is used in the VCS and Sirocco verification software products | | | |
| 1999 | **Apteq** | | | X | | | | X | | X | X | X | X |
| | Notes | | | | | | Added expertise in analog simulation and Verilog-A product. | | | Extended the verification BU with engineering expertise the on extensions for Verilog language. | | | |
| 1999 | **Covermeter* from Advanced Technology Center of Massachusetts** | | | X | | | | X | | | X | | |
| | Notes | | | | | | Acquired the rights to CoverMeter, a Verilog code coverage tool | | | | | | |
| 1999 | **Smartech OY** | | | | | X | | X | | X | X | X | X |
| | Notes | Finnish firm | | | | | A privately held design services firm with expertise in the design of wireless communication devices | | | Increased the offering design services in Europe and added 35 talented consultants to Professional services. | | | |
| 1998 | **System Science Inc.** | | | X | | | | X | | X | X | X | X |
| | Notes | | | | | | Added tools for electronic design Verification and test | | | Added verification technologies such as VERA(TM) testbench automation system. Add engineering talent to the Simulation Tools Group | | | |
| 1997 | **ViewLogic Systems Inc.** | | | X | | | | X | | X | X | X | X |
| | Notes | | | | | | Provided a wide range of EDA products as well as a full range of support services. | | | Added technologies as well as both development talent and sales force with experience within ASIC verification tools | | | |

| Year | Company acquired | IP and Systems | Implementation | Verification | Manufacturing | Services | Domain Strengthening | Domain Extension | Domain Exploration | Operational Resource Sharing | Transfer of functional skills Functional Skills | Transfer of General Management Skills | Combination Benefits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Only tech assets, not company acquisitions | | **Product Portfolio** | | | | | **Type of acquisition** | | | **Type of Strategic Capability Transfer** | | | |
| 1997 | **EPIC Design Technology Inc.** | | | X | | | | X | | X | X | X | |
| | Notes | | | | | | | | | Was acquired to broaden their product offerings and have one company with the best in expertise and best in market position in both high-level design and deep submicron. | | | |
| 1995 | **Arkos Inc.** | | | X | | | | X | | X | X | | |
| | Notes | | | | | | Expansion into Hardware emulation | | | Added Hardware emulation technology as well as engineering talents with emulation. Not much was transferred as the firm was sold a year after. | | | |
| 1995 | **Silicon Architects Inc.** | X | | | | | | X | | X | X | X | X |
| | Notes | | | | | | Acquisition of the Pioneers of the Structured ASIC(TM) Methodology | | | Added patented ASIC design technology as well as engineering talents. The firm was integrated by forming a new business unit. | | | |
| 1994 | **CADIS AG** | X | | | | | | X | | X | X | X | X |
| | Notes | | | | | | Added DSP design tool suit and communication systems as well as experts such as Joachim Kunkel | | | Through this acquisition Synopsys got the communication systems and DSP design tool suit named COSSAP (Communication System Simulation and Application Processor) | | | |
| 1994 | **Arcad SA** | | | X | | | | X | | X | X | X | X |
| | Notes | | | | | | | | | Added VHDL models for telecommunications standards As well as engineering talents such as Dr. Michel Tabusse | | | |
| 1994 | **Logic Modeling Inc.** | | | X | | | | X | | X | X | X | X |
| | Notes | | | | | | | | | Added simulation models and modeling technologies for the verification of electronic designs. And R&D talents | | | |

### 5.4.1 Acquisition types

The *Domain Strengthening* acquisitions are very limited, as this type of acquisitions is mainly aimed at defending the firm's market position through the acquisition of competitors with similar or overlapping products (Haspeslagh and Jemison, 1991). Thus, possesses very similar knowledge bases and therefore only provide limited performance increases (Makri, Hitt, and Lane, 2010). Therefore it is only Synopsys's acquisition of their major competitor Magma Design Automation Inc., which fits this type of acquisition.

The vast majority of the acquisitions conducted by Synopsys are *Domain Extensions,* as they extend capabilities in current market or expend capabilities in new adjacent markets (Haspeslagh and Jemison, 1991). The extensions of the capabilities in existing markets are exemplified by e.g. the Virage Logic Inc. acquisition increasing Designware® IP portfolio with Analog IPs, and the InnoLogic Systems Inc. acquisition extending Professional Services with research and verification services. The Simplicity acquisition is a great example of expanding capabilities in new markets as a whole new business area of FPGA design was created following the acquisition (INTV 6, 2013). Thus, most of the acquisitions take place in their core market, which significantly reduces the risk but also potential gains (INTV 6, 2013).

*"The acquisitions we are doing are not in unknown waters. It is very limited risk, as it is all in our core domain."*
*- INTV 6 (2013)*

Lastly, *Domain exploration* has been utilized in some of the recent acquisitions of firms operating within Photonics. Through the acquisitions of RSoft, VaST Systems Technology Corporation and Optical Research Associates, when the Synopsys management team has little experience but the general management skills from the EDA industry can be applied (INTV 6, 2013). These acquisitions are used by Synopsys to possabilities in adjecent industries, as the consolidation in EDA is very high, and few new possible acquisitions target emerge in the industry, which may be caused by the financial crisis (INTV 6, 2013).

*"The financial crisis has led to a consolidation of the industry (EDA), reducing the possibilities for startups to obtain venture capital and succeed in the industry."*
*- INTV 6 (2013)*

### 5.4.2 Strategic capability transfer

As it is apparent from the table above *Operational Resource Sharing* is a highly utilized type of capability transfer from the acquired firm to the target. It is used to cut cost of the non-core activities of the acquired firms through divestiture of unnecessary human resources in administration and sales (INTV 6, 2013). In all Synopsys acquisitions *Operational Resource Sharing* is an important part of the integration process, as the identification and optimization of redundant resources as well as the redeployment of resources are important for the success of the process (Capron et al., 1999). However in few acquisitions such as the ADA Inc. and the Optical Resources Associates the added benefits has been limited due to the difference in the market structure compared to the core EDA markets, therefore the firms has been kept with their original R&D, Technical and Sales people (INTV 6, 2013; Synopsys, 2004).

### 5.4.3 Transfer of functional skills

In capability transfer the long-term source of value creation is created by the effective transfer of functional skills between firms (Haspeslagh and Jemison, 1991). The purely technological acquisitions like C level design, VirSim and TriCN Inc., of proven technologies underlines the focus, but also reveals that employees are, in some cases, only needed as consultants in the integration phase in order to transfer the functional skills (INTV 6, 2013). The same goes for the sales staff in cases where the acquisitions add new products, they are only there for a limited period of time to successfully transfer their functional knowledge to the existing sales people (INTV 6, 2013).

*"The more difficult a capability is to imitate, the longer it will take to learn and apply."*
*- Haspeslagh and Jemison, 1991; 109.*

This is exactly the case with capabilities of Optical Research Associates and Silicon Architects. In acquisitions like these the acquired firms are slowly integrated by creation of new business units with their assets (INTV 6, 2013).

### 5.4.4 Transfer of general management skills

As with, *Operational resource sharing, transfer of general management skills* is a widely applied way of transferring capacities from Synopsys to the target firm, which is applied in most acquisitions. Thus, value creation is happening through organizational linkages (Puranam et. al, 2003). The only exceptions are purely technological asset acquisitions such as MoSys and MOSAID acquisitions, and Domain Exploration Acquisitions as Optical Research Associates and RSoft Design Group. Transfer of general management skills, in Synopsys acquisitions, mainly occurs through implementation of corporate wide computer systems for financial planning and control purposes as an integrated part of the acquisitions milestones (INTV 6, 2013; Haspeslagh and Jemison, 1991). The milestones are expanded upon in the analysis of the *Integration Process.*

In some cases the *Transfer of general management skills* occurs indirectly through the integration of the acquired firms into existing business units, as it has been the case for many of the IP related acquisitions such as Virage Logics Inc., Inventure Inc. or Extreme DA within verification. However, very explicit in the cross-border acquisitions, where the sites is kept e.g. Leda Design in Armenia or ChipIt in Germany (INTV 6, 2013; INTV  INTV 2, 2013, 2013).

### 5.4.5 Combination Benefits

Size-related benefits are mainly occuring in the form of increased market power, in Synopsys acquisitions. With the recent acquisition of Springsoft, Synopsys expended their scope of their implementation platform as well as increasing their market position in South Asia (Synopsys, 2012 b). Moreover, the addition of RSoft and VaST technology has increased market power in the adjacent photonics, by proving customers with additional tools to reduce manufacturing costs.

### 5.4.6 Sumarizing Synopsys acqusition history

This analysis confirms that Synopsys is a large and dominant acquirer within the EDA industry, consistent with Kleer and Wagner (2012) and that Synopsys acquire both IP and design tools. The analysis also reveals that the majority of the acquisitions are *Domain Expansions* in the EDA industry or to adjacent markets where the market specific skills can be applied. Thus, minimizing their risk, as most of the acquisitions are done in well established markets (INTV 6, 2013). However, with the *domain exploration* into the Photonics industry Synopsys has recently acknowledged that they have to move into unknown waters to continue their expansion. The findings indicated very limited use of *Domain Strengthening,* as this type provides very limited gains in future performance due to the high similarity of the product port-folios.

In transferring capabilities from Synopsys widely applied all four types of transfers, as goals of most of the acquisitions were to add new capabilities and expand existing platforms. Thus, most of the acquisitions can be *capacity driven* (Haspeslagh and Jemison, 1991). Only few acquisitions added new platforms to the existing portfolio, e.g. Optical Research Associates, Synplicity. As Synopsys is also focusing on acquiring a *business position*, only one out of the 46 acquisitions, the 2012 acquisition of Magma fit this description (ibid.). Hence, by focusing on the *transfer of strategic capabilities* Synopsys is applying a process perspective to their acquisitions, increasing integration performance (Haspeslagh and Jemison, 1991). Based on table 4, it is clear that the majority of the acquisitions were domestic (72%), making the integration easier and faster (Muehlfeld, Sahib, and Witteloostuijn, 2012).

# 6 Analysis of Synopsys acqusition management

The previous section provided an empirical analysis of the industry in which Synopsys operates and some insights into the company it self and its competitive environment. In the following chapter the six interconnected elements of the theoretically deducted ETA model, all affecting post acquisition performance, are tested based on qualitative data collected through a number of interviews with key Synopsys employees.

One of the important aspects for Synopsys in their acquisitions is the retention and integrations of the competences and tacit knowledge embodied in key employees from the acquired company. The importance of retaining key competences is a central part of the first element be analyzed, *Human Capital*.

In 2004 the executive board of Synopsys turned against their CEO and cancelled the planned acquisition of MoSys, a small memory start-up, one of the reasons being that MoSys had pending patent infringements for the core technologies (Santarini, 2004). Synopsys have previously suffered substantial losses due to infringements of acquired companies ( INTV 6, 2013). Thus, Synopsys is utilizing experience from previous acquisitions. Hence, *Learning From Experience*, the second element of the model is evident.

Experience and knowledge of the current product portfolio is also important when identifying possible targets for acquisitions to generate value for Synopsys they need to add new technologies and competences different to the ones in their current product and R&D portfolio ( INTV 3, 2013). Hence, *Complementary*, the third element, is critical in order to increase post acquisition performance.

Acquisitions are used by Synopsys to get access to complementary new technologies, using acquisition to complement internal R&D. However, how this approach effects performance is analyzed in the section on *Innovation performance.*

Another aspect of importance in the industry, in which Synopsys is operating is the central role of industry wide technological road maps providing Synopsys, and all other players in the industry with insights on, which new technologies customers will required in the future ( INTV 6, 2013). The importance of road maps is expanded in section 6.5, *Technological Fit.*

As the majority of the acquired company's contains high internal relatedness, with similar organizational culture, and managerial styles, most of the acquired companies are integrated into Synopsys within 100 days ( INTV 3, 2013; Homburg and Bucerius 2006). What happens when fast integration is too fruitful is analyzed in detail in the final element, section 6.*6 the integration process*.

The following section will shed light on the importance of retaining and integrating key acquired employees.

## 6.1 Human capital

Post-acquisition implementation challenges are among the primary reasons acquisitions do not succeed in achieving their desired objectives and have undesired results (Haspeslagh and Jemison, 1991). This can partly be ascribed to differences in organizational cultures and the loss of key employees in the acquired company (Ranft and Lord, 2000). While much research has focused on the top management team of the acquisition target (Ranft and Lord, 2000; Cannella and Hambrick, 1993). This thesis finds that the retention of individual and collective competences is a central concern because valuable employees have the ability to leave in the integration period, resulting in the loss of competences. The aim of the following analysis is to evaluate; *How does Human Capital affect competence-based acquisitions, and how is it managed?*

Synopsys acquisitions of smaller companies are targeted at enhancing their strategic technological capabilities (see table 5; INTV 3, 2013). These capabilities are embedded in the tacit and socially complex knowledge of the acquired companies' individual and collective *Human Capital* (Coff, 2002). From a competencies -focused view companies are dynamic stores of different knowledge accumulations that are dependent upon the organization's individual and collective *Human Capital* (ibid.). Seen form a competence-focused standpoint, the reason for Synopsys acquisitions is that knowledge is highly tacit and socially complex, and therefore is a valuable competitive resource and very difficult to imitate. On the other hand, for Synopsys the tacitness and social complexity also makes it difficult to manage, particularly in acquisitions ( INTV 3, 2013). Synopsys acquisitions aim to create value through integration ( INTV 3, 2013). This means not only exploiting existing synergies, but also changing the acquired company (see section 5.4). The companies that Synopsys acquire are typically smaller, and are integrated into Synopsys structure over time. Hence, an acquisition by Synopsys will bring organizational changes.

### 6.1.1 Dividing acquired human capital into functions

Even though *Human Capital* is acquired as an entity, there is an academic and managerial benefit in dividing acquired competences, embedded in Human Capital, into functions. The research team noted major differences between the usefulness of the competences acquired for Synopsys. Interviews revealed that functions relevant to synopsis were:

- Leadership
- Administrative
- Marketing and sales
- Research and development
- Technical

Synopsys sales and marketing has been small compared to competitors, as the focus has been development ( INTV 6, 2013; INTV 2, 2013). Marketing, sales and administrative roles can be handled by Synopsys centralized staff after an acquisition, and bears no value to Synopsys ( INTV 3, 2013). Hence, in the integration phase these functions are moved away from the acquired company and staff for these functions are laid off ( INTV 3, 2013; INTV 6, 2013).

*"You do not need all the people in infrastructure, HR, administration, finance, sales and marketing; you will have to rationalize that."*
*- INTV 3 (2013)*

Hereby, Synopsys streamline the acquired organizations through the rationalization of overlaps in resources such as accounting functions, IT-systems and legal policies (INTV 3, 2013 , 2013; INTV 6, 2013). This rationalization of redundant human resources is a natural part of the integration process, and if it does not happen the efficiency of the organization is significantly reduced (Capron, 1999). The findings are consistent with the analysis of the acquisition history, where *operational resource sharing* through resource redeployment and the divestiture of redundant human resources was found to be an important part of the transfer of strategic capabilities (Haspeslagh and Jemison, 1991; Capron, Dusssauge, and Mitchell, 1998). Thus, through *operation resource sharing* and the interactions between Synopsys employees and acquired employees, the organizational processes are shaped and organizational capabilities are altered and new ones emerge (Felin, et al. 2012). A part of the process is to clean out the overlap; it is easy to do this related to the acquisition ( INTV 1, 2013). This is consistent with research on the topic, which views acquisitions primarily as mechanisms for achieving scale efficiencies and market power (Capron, Dusssauge, and Mitchell, 1998). Thus, in line with the finding of Capron (1999), acquisitions enable acquirers to redeploy resources to its target and rationalize its resources contributing to increased acquisition performance.

In few acquisitions where the acquired products are unique, such as the Avanti and ViewLogic acquisitions, sales and marketing specialists were retained due to the product specific tacit knowledge they possessed, partially consistent with the findings of Ranft and Lord (2000).

### 6.1.2 New leadership after an acquisition

The personality of the top management of the acquired companies plays an important and distinguishing factor for the success of the integration process ( INTV 3, 2013). Interviews revealed that Synopsys are not focusing on retaining the acquired leaders, especially managers of the small companies ( INTV 2, 2013). These entrepreneurial spirits are not able to work under the high bureaucracy of established organizations ( INTV 1, 2013; INTV 3, 2013).

*"There are some people who are just entrepreneurial, who wants to live in start-ups. They are not comfortable in the environment of a larger company like Synopsys."*
*- INTV 3 (2013)*

In the case of the Company 1 integration, the founder did not foster the integration of the company into Synopsys ( INTV 2, 2013). The integration phase was actually more troublesome because the founder worked against it (ibid.). Thus, actions on an individual level affect the organizational performance, which may be caused by his goals not being aligned to those of the organization, resulting in the detrimental effects on the process (Felin et al., 2012) .

*"The founder (of Company 1) worked against the integration process and tried to protect the company, as if it was his own."*
*- INTV 2 (2013)*

Moreover, the integration was further hampered by a poor site manger taking over after the founder left ( INTV 1, 2013). Inconsistent with the findings of Graebner (2004), it can be argued that entrepreneurial leaders create conflicts rather than resolving them.

While the more entrepreneurial managers stay only for a short while and add little value, the many acquired managers with competences and personality suited for a large, at times, bureaucratic company have successfully pursued a continued career in Synopsys ( INTV 3, 2013).

Consistent with Graebner (2004), acquired leaders that stayed with Synopsys have been able to foster change within the organizations, and have enabled realization of planned, and sometimes unknown, synergies ( INTV 3, 2013, INTV 2, 2013). Thus, acquired leaders with the right mindset foster change and enable the realization of planned, and sometimes unknown, synergies.

### 6.1.3 Technological R&D capabilities constitutes the value

Valuable knowledge will be present in individuals and relationships throughout the entire acquired organization, in many different functions and levels. Even though this thesis has shown that the managers Synopsys acquires are likely to possess valuable managerial knowledge, much of the acquired technological competences are within R&D departments and the technical support staff ( INTV 6, 2013; INTV 2, 2013). These functions are important for further development and sales of the product portfolio acquired (ibid.). Hence, the real value realized by Synopsys acquisitions is in the capabilities of R&D. This is consistent with the literature review, which found the retention of key employees to be a critical precondition for the successful transfer of capabilities and new knowledge based technology (Ranft and Lord, 2000). Hence indicating that Synopsys lower level employees, such as R&D technicians and engineers, may be crucial for successful integration and post-acquisition performance ( INTV 1, 2013). Since Synopsys is operating within a high tech industry, the most important assets in the acquisitions they make are the human resources, mainly the engineering capabilities ( INTV 3, 2013).

*"We are acquiring two things, one is technology and the other is engineering resources."*
*- INTV 3 (2013)*

This makes it more important for Synopsys to identify development engineers, and retain them in the organization. Theanalysis of the last 20 years of acquisitions shows that Synopsys is successful in retaining engineers. This result is supported by interviews with managers.

*"I think we have a quite good track record at retaining these (engineers). I think we have done very well"*
*- INTV 3 (2013)*

Thus, in line with the literature review, concluding that the strategic importance of retaining *Human Capital,* within R&D, is especially vital for knowledge-intensive acquisitions (Ranft and Lord, 2000; Coff, 2002).

### 6.1.4 The price of the best

Due to the strong focus on the quality of Synopsys products released to customers, customers report that the quality of the acquired company's product portfolio are increasing after Synopsys takes over the company ( INTV 2, 2013). However when acquiring there is a risk of paying a premium, due to the importance of *Human Capital* in Capital-intensive industries (Coff, 2002).

In Synopsys pre-evaluation of potential targets a maximum price for the target is identified ( INTV 2, 2013,2013). As a result, Synopsys has lost some target to competitors willing to pay a higher premium ( INTV 2, 2013). Thus, consistent with the findings of Coff (2002), as the risk of paying a premium is mitigated by acquisition experience.

In some cases the competing companies have paid a too high premium, and were later acquired by Synopsys for a lower price that they initially offered for the target ( INTV 2, 2013).

### 6.1.5 Retention of competences

Key employees embody an acquired company's *Human Capital* and, are therefore enable all technological capabilities. Competences acquired are located at various levels and functions of the company (Badaracco, 1991; Nonaka, 1994). Because the acquisition of key employees' competences is the motivation for the acquisition, their retention constitutes the success of the acquisition (ibid.). Ranft and Lord (2000) show that higher retention of key employees throughout the acquired organization does result in significantly greater transfer of knowledge-based resources to the acquirer. In the post-acquisition process, Synopsys is scanning for key employees to retain acquired competences, uses stock options and performance based-bonuses ( INTV 1, 2013). This is inconsistent with Ranft and Lord (2000), who concludes that the way to retain these key individuals is through intrinsic rewards such as autonomy, status, and commitment by the acquiring companies top management, rather than extrinsic rewards such as bonuses and other economic incentives (Ranft and Lord, 2000).

An effort to retain key employees is not only important to control individual knowledge, but also for preserving knowledge that is socially complex (Ranft and Lord, 2000). After a Synopsys acquisition, not all of an acquired company's competence will be contained within specific individuals. Critical competencies are often embedded in relationships among individuals, rather than in a particular person (Ranft and Lord, 2000). Hence, much of Synopsys newly acquired knowledge will be bound to formal and informal networks within the organization, and even across organizational boundaries. This makes it crucial for Synopsys not only to map and retain key employees, but also the social structure, as these structures lay the foundation for knowledge sharing and knowledge development within the acquired employees (Felin, et al. 2012). In relation to this, it was found that the *preservation*-method, as presented by Haspeslagh and Jemison (1991) is very valid. When Synopsys acquired Company 1, the structure was preserved and much of the ongoing development work at Company 1 was kept intact and even enhanced ( INTV 1, 2013). There were technical redundancies in the Company 1 development, but they were not completely rationalized. If this was intended by the acquisition team, or just a lack of competence-mapping, is not clear, but the retention results are positive to this point. Company 1 had 15 development engineers when they were acquired, and today they are 60 ( INTV 1, 2013). Over 50 % of the original staff is still in the new organization in similar positions in development (ibid.).

The interviews revealed that, for development engineers, the difference between working for Synopsys and a small company, were not noticeable. Even though compensation-systems differed, the end salary was very similar, and motivational differences in the pay-system seemed insignificant. HR seems to be very minimal in Synopsys with no development programs or specific management, and even though this must be very different from a small organization, this did not seem to be concerning any interviewees. It would seem development engineers are happy with remaining in the organization after an acquisition. This may be because a larger organization provides more structure and security. With Synopsys acquisition of Company 2 4-500 engineers stayed in the company, out of 800 People, even though there were several other job-offers ( INTV 2, 2013).

With regards to *Human Capital*, the implementations phase of an acquisition, also play an important role. An important implementation step would be to retain managers for a period of time into the integration. This has been shown to provide a smoother transition and to gain loyalty of key R&D, engineering, sales, and middle management employees (Ranft and Lord, 2000). This is inconsistent with the interviews, as it seem not to be a concern for Synopsys, and only few thoughts on this were noted concerning sales personnel and transitions of contracts ( INTV 6, 2013;  INTV 3, 2013;  INTV 2, 2013; 2013).One of Synopsys main focuses in acquisitions is the retention of key employees ( INTV 3, 2013), as knowledge embedded in individuals are the main asset in high tech industries (Coff, 2002). Due to the strategic importance of the employees in the acquired companies, all acquisitions have been friendly and the management of the acquired companies has been actively involved in the integration process ( INTV 3, 2013; Muehlfeld, Sahib, and Witteloostuijn, 2012).

### 6.1.6 Summarizing human capital

The analysis has shed light on several aspects of how acquired *Human Capital* is integrated and retained. First, the analysis has shown how acquired *Human Capital* can be divided into functions, and that Synopsys, in most cases, only value acquired R&D functions. While engineers stay, sales and administrative employees are in most cases let go. They can be useful to retain, but in most cases represent no real value post-acquisition to Synospys. Consistent with existing research, the divestiture of redundant human resources was found to be a natural part of the integration process. Partially consistent with literature, sales and marketing specialists were retained due to their product specific tacit knowledge when the acquired products were unique.

It is evident that Synopsys do not make a special effort to integrate acquired leaders, and that entrepreneurial leaders can disrupt the integration process e.g. by continuing to act as if they own the company, contradicting theory. However, in line with theory, the Synopsys acquisitions history also shows that many acquired leaders, with the right mind-set, have had a long career in the company. Thus, acquired leaders with the right mind-set foster change and enabled the realization of planned, and sometimes unknown, synergies. The integration of R&D functions and retention of engineering talent was shown to be of strategic importance and especially vital for knowledge-intensive acquisitions. As the retention of key employees is a critical precondition for the successful transfer of capabilities and new-knowledge-based technologies, which is congruent with the findings in the literature review.

Acquisition of *Human Capital* is difficult to valuate prior to the acqusition and consequently Synopsys might have to pay a premium. In line with theory arguing that in human intensive industries there is a risk of paying a premium for highly talented engineers. However, acquisitions experience mitigates the risks of paying a premium.

Retention of acquired leaders during a transition period were found not to increase employee loyalty, contradictory to existing literature. Moreover, to retain acquired leaders Synopsys relayed heavily on extrinsic financial rewards rather than primarily intrinsic as suggested by literature.

All acquisitions have been friendly due to the strategic importance of the employees in the acquired companies.

## 6.2 Learning from experience

Following Haspeslagh and Jemison (1991) findings, this section will analyze how Synopsys can gain a strategic advantage by understanding and enhancing the integration process. Synopsys has been very eager to learn from previous experiences with acquisitions and apply the knowledge to future acquisitions ( INTV 2, 2013). This section will show how experience with acquisitions can create a skill set that can be used strategically, and how Synopsys does this. Through answering the following sub question: *How can organizational experience with competence-based acquisitions be used strategically?*

### 6.2.1 Codifying previous acquisitions

For companies to obtain value from previous acqusition experiences, the knowledge obtaineded thorugh these acquisitions need to be codified (Zollo and Singh, 2004). This research has shown that Synopsys gather knowledge to enhance acquisitions primarily from feedback surveys conducted with involved employees and as well customers ( INTV 3, 2013). Internet-based surveys with close ended questions are primarily used (ibid.). This makes the data gathered dependent on respondents' motivation, honesty, memory, and ability to respond, and hence the data could be very biased.

The interviewed engineers of this thesis also had a strong tendency to fall for a self-selection bias. Synopsys want to ensure that their customers are experiencing minimum effects from the acquisitions; therefore, their feedback on their perception of the integration phase provides valuable feedback used to improve the integration process of future acquisitions ( INTV 2, 2013).The learning and knowledge from each acquisition is codified and used to improve the future process ( INTV 2, 2013).

*"We have done so many so that we have gotten the experience to make them successful."*
*- INTV 3 (2013)*

Thus, codifying knowledge from previous experience in order to improve the internal integration process of future acquisitions, as well as minimizing customer disadvantage caused by the acquisition (Zollo and Singh, 2004; Coff, 2002; Hitt et al., 2001). Hence, improving internal structures to ensure that they established the right context for sharing the codified knowledge to create new organizational capabilities for Synopsys (Felin, et al. 2012).

*"The last couple of acquisitions follows a very rigid process, which our customers now have learned making communication with them easier"*
*- INTV 6 (2013)*

As presented in section 5.3, Synopsys have a long history of acquisitions. This constitutes the foundation of the experience learning potential, but requires the knowledge to be codified. Much of the publicly accessible information from Synopsys concerns success stories of previous acquisitions, but interviews quickly revealed that there have been a lot of learning potential in failures too (INTV 6, 2013). Consistent with Muehlfeld, Sahib, and Witteloostuijn (2012), learning from mistakes is just as important as learning from success, considering acquisitions (The EPIC Design Systems and Company 2 acquisition will be analyzed in the next section). On the other hand, due to political and managerial struggles, the relevant information may never be codified into organizational learning. Thus, Churchills old words "History is written by the victors" seem to be relevant in this context. Interviews revealed both relevant experience learning, and cases of knowledge concealment due to internal self-interests. An avenue still untouched by existing literature on corporate acquisitions.

### 6.2.2 Enhancing the acquisition process by learning

Knowledge of the acquisition process can be codified to increase future performance, consistent with prior academic findings (E.g. Zollo and Singh, 2004; Coff, 2002). Hence, the interactions of individuals' organizational capabilities are created through the development of effective processes for handling the integration phase (Felin et al., 2012; INTV 6, 2013). The codification of knowledge and application in future acquisitions is exemplified in the acquisition of Company 2. The acquisition of Company 2 was relatively smooth, primarily because of prior experience with the EPIC Design Systems acquisition ( INTV 2, 2013). This acquisition did not only result in problems with the integration phase, it also created long-term problems for Synopsys ( INTV 2, 2013). A part of the management team at EPIC left Synopsys and formed the Nassda Corporation, which engaged in direct competition with Synopsys using key resources from the acquired company ( INTV 2, 2013; NYTimes.com, 2004). Based on the settlement and later acquisition of Nassda in 2004, Synopsys learned a valuable lesson of how much autonomy to grant to acquired companies and how to integrate these enough to ensure that the Synopsys is still on top of the main decisions in the company ( INTV 3, 2013). This trade-off between coordination and autonomy is a central aspect in the integration phase. When identifying the goals of the integration process in terms of focusing of leveraging existing knowledge to create or leveraging the capabilities of the acquired company (Puranam and Srikanth, 2007). The trade-off between these is expanded upon in section 6.5.5 *Exploration vs. Exploitation.*

Synopsys learned from the mistakes made during the integration EPIC Design Systems, and developed important insights into how to successfully handle the integration of large acquisitions (McGrath, 1997; INTV 2, 2013). On the other hand, there were still learning potential in the integration of Company 2. Even through the integration was now planned, unforeseen problems occurred between two units integrated into one. This created internal power struggles, which resulted in the strict integration policies on 90 days to define how to integrate the products and employees, and communicate this to the customers ( INTV 2, 2013).

*"The great thing about going through this is that we already have the experience"*
*- Dr. de Geus, CEO of Synopsys (McGrath, 1997)*

Thus, Synopsys are successfully utilizing their experience in large acquisitions to ensure successful integration and increase performance (Ellis et al., 2011). The knowledge gained through acquisitions is codified in internal road maps, which ifluences R&D ( INTV 3, 2013). However, contrary to the finding of Ellis et al., (2011), Synopsys has also been able to utilize their experience in small acquisitions to improve the integration process and thus the company performance ( INTV 2, 2013). Consistent with Hitt et al., (2001) Synopsys experience with acquisitions seems to have enhanced the performance of the acquisition process, causing a shift in organizational innovation focus, to an acquisition strategy, rather than internal development.

### 6.2.3 Gathering knowledge in a uniform environment

The codified knowledge for acquisitions has been stored at all levels of the organization, especially at top management level. As, Synopsys executive management team have remained unchanged for a long time ( INTV 2, 2013; Synopsys, 2013 a). Even as new business areas have been pursued by Synopsys, the executive management team has been constant for many years ( INTV 3, 2013; INTV 2, 2013).

*"Since the acquisition of* company 3, *where I came into the company, the executive management team has not changed"*
*- INTV 6 (2013)*

Thus, Synopsys are creating a large and consistent knowledge base in the executive management team, ensuring an organizational memory. This act both as a strength and weakness, in the sense that knowledge of the direction is important. On the other hand, at that same time creating an obstacle for the further development of the company, as the

| Name | Position | Acquired firm |
|---|---|---|
| **John Chilton** | Senior Vice President, Marketing and Strategic development | CEO, ARKOS Design, acquired in 1995 |
| **Manoj Gandhi** | Senior Vice President and General manager, Verification Group | ViewLogic, acquired in 1997 |
| **Dr. Howard Ko** | Senior Vice President and General manager, Silicon Engineering Group | CEO, Avant!, acquired in 2002 |
| **Joachim Kunkel** | Senior Vice President and General manager, Solutions Group | Managing director, CADIS GmbH |
| **Dr. Poul Lo** | Senior Vice President and General manager, Analog/ Mixed Signal Group | President, Avant!, acquired in 2002 |
| **Joe Logan** | Senior Vice President of Worldwide Sales | Head of North American Sales and Support, Avant!, acquired in 2002 |

*Table 6 Executive Management from acquired companies (Synopsys, 2013 a)*

executive management team may not provide many inputs to innovative ideas (INTV 6, 2013). Hence, the static executive management can result in less radical change and enforcing status quo, consistent with the findings of Makri, Hitt, and Lane (2010).

*"Synopsys is at times its own worst enemy. As the executive management is only focused on copy what worked well in the past and not trying out new approaches"*
*- INTV 2, (2013)*

The IC-industry is dominated by US based companies, and most of these companies are located in Silicon Valley (INTV 6, 2013). Based on the analysis of the acquisitions is it apparent that more than 70% of the acquisitions are of domestic US based companies (see Table 4). As the applied knowledge is very specific, most employees in the IC industry have an engineering background, even in managerial functions ( INTV 3, 2013; INTV 2, 2013). This makes the industry very uniform. Synopsys have been able to acquire and retain leaders all over the organization from previous acquisitions ( INTV 3, 2013). From table 6, on the privious page, it is evident that 6 out of 13 people in the executive management team themselves, are from acquired companies, which ensures that the experiences from acquisitions and integrations stay in the company. The level of acquired leaders is consistent from in the rest of the organization ( INTV 3, 2013)

*"Many of the leaders of the company have come through acquisitions"*
*-INTV 3 (2013)*

This shows how Synopsys have been able to integrate acquired leaders successfully into the organization, and hereby secure experiences from acquisitions directly into the company. On the other hand, acquired leaders seem to be similar to the rest of Synopsys. The result is that much of the experience from acquisitions can be kept in Synopsys. On the other hand, this also results in a very uniform environment, where gathered knowledge will be equally uniform. In their evaluations of acquisitions Synopsys primarily emphasize the financial measurements ( INTV 1, 2013). Which is related to the Synopsys internal organizational learning, because the financial success factors will dictate how and what knowledge that will be gathered. As acquisitions are highly technological motivated, researchers argue that evaluations should also include acquired technological and scientific knowledge stocks (Makri, Hitt, and Lane, 2010).

### 6.2.4 The acqusition team

Synopsys was found to underestimate the vastness of the integration task, even in closely related acquisitions, which resulted in lower innovation performance (Ahuja and Katila, 2001; INTV 3, 2013). When Synopsys integrates an acquired company, various business units send relevant personnel with the relevant skills to handle the process ( INTV 3, 2013). The business unit representatives are responsible for the integration of acquired companies ( INTV 2, 2013). Within HR and finance the unit representatives are responsible for their part of the acquisitions. Planning of the integration begin 4-6 weeks before the acquisition. A limited team will be working on the planning due to the high level of confidentiality needed; the team is led by an internal integration unit ( INTV 3, 2013). The actual integration phase is done by the business unit, in which the acquired company is to be integrated, together with people form Synopsys internal integration unit, as well as managers or representatives from the acquired company (ibid.). This seem contrasting to relevant academic literature on the subject. Instead Synopsys could have a specific team, with the purpose of ensuring that integration follows the strategy, and utilized previous acquisition experience. Haspeslagh and Jemison (1991) and Laamanen and Keil (2008) recommends an internal unit dedicated to the task of managing post-acquisition integration has positive effects on acquisition performance. This team could also document the integration process and ensures that the knowledge is codified and used to improve the integration of future acquisitions, as recommended by Laamanen and Keil (2008).

### 6.2.5 Summarizing learning from experience

This section of the analysis set out to analyze in which ways experience from past acquisitions can be applied to improve future acquisitions. Based on the analysis, Synopsys was found to codify and learn from experience from previous acquisitions in several ways. By learning from their mistakes in terminated and unsuccessful acquisitions, consistent with existing theory. Moreover, the acquisition process codification was found to increase future performance for Synopsys, in line with existing research.

Organizational politics and self-interest may hinder acquisition codification, an avenue untouched by existing literature. Contradictory to existing theory, Synopsys is able to use experience from small acquisitions to improve the integration process of larger acquisitions. By uterlizing their heir experience in large acquisitions, Synopsys are able to ensure successful integration and increase performance, consistent with existing research. One of the reasons for the effective codification of prior experience may be that Synopsys have a static management team, which is resulting in a large knowledge base and incremental innovation in line with the literature review. Thus, the analysis found that acquisition experience can be stored by integrating acquired managers. Furthermore, contradictory to literature, Synopsys was found to primarily base their acquisition evaluations on financial measurements, rather than e.g. organizational learning, competences gained ect. On a different note, the analysis shed light on how Synopsys manages acquisition processes, and how this might be improved by having dedicated team(s) managing all post-acquisition integration(s), drawing findings from existing literature. PCI Express (Peripheral Component Interconnect Express) is a high-speed port for expansion cards used in computers for various expansions. Most modern computer will include this interface

## 6.3 Complementarity

The review of relevant literature found similarity and complementarity of the acquirer's and the target's technological knowledge to be an important predictor of post-merger innovation performance. This section will analyze the complementary requirements and benefits of Synopsys acquisitions. Showing that successful post-merger innovation calls for a balance between both the specific knowledge needed and the right distance in competences by answering the sub question; *How can acquisitions secure complementary technological and organizational assets?*

### 6.3.1 Not just any new knowledge

The overall goal of Synopsys acquisition strategy is to broaden and enhance a technology portfolio, which aims to create a complete software suite of all necessary software tools to design microchips ( INTV 3, 2013). The synergy is accelerating as the portfolio is getting broader, and this saves resources for both Synopsys and their customers ( INTV 3, 2013; INTV INTV 5, 2013, 2012).

*"We are experiencing a strong synergy effect due to the complementary of the product portfolio."*
*- INTV 5 (2013)*

An ever-changing technology portfolio places great emphasis on what particular competences Synopsys acquires. Not just any new technology or tool code will be integrable into the business, even if it is technologically relevant. Consistent with prior research (e.g. Makri et al., 2010), complementary knowledge was found to increase invention quality in Synopsys acquisitions. On the other hand, it must also be considered that it is not the technology that is valuable; it is the competence behind that produces the next version ( INTV 1, 2013). The Cascade Inc. acquisition in 2004 provided Synopsys with IP for the first generation PCI Express[1] (PCIe), but more importantly also 10 engineering experts

1 PCI Express (Peripheral Component Interconnect Express) is a high-speed port for expansion cards used in computers for various expansions. Most modern computer will include this interface

developing of 2nd and 3rd generation PCI (PCIe) generating revenue of $133.60 million since the companies or almost 9 times the money Synopsys invested (Esteve, 2013). Hence, consistent with our assumption good and structured integration process provides financial gain.

Thus, it is evident that the real value generation is gained by utilizing the acquired competences and by having internal structures enabling the coordination between employees to further develop existing technologies though efficient collective action (Esteve, 2013; Felin, 2012).

With Synopsys emphasis on the capabilities the R&D process becomes central, as all ICs are doubled in efficiency every 18 months according to "Moore's law" (Miller and O'Leary, 2007). So it is not just a question of an acquired technological asset will be beneficial to the current portfolio, but rather if the people behind it can be integrated in order to make the next software version even more well suited for the overall software solution ( INTV 3, 2013; INTV 1, 2013).

Consistent with existing literature, the real value is embedded tacit and social complex knowledge in the minds of key employees of the acquired company (Ranft and Lord, 2000). Hence, the integration of key employees is important to leverage the real value of the acquired competences to develop next generation software. Therefore, s*tructures* needs to foster the knowledge sharing and create the learning processes needed to utilize these new capabilities (Felin et al., 2012).

*"It is the technology, and the people Synopsys are interested in. (...) to be able to develop the next version."*
*- INTV 1, 2013*

Synopsys acquires new competences, and thereby a broader technology portfolio to their software suite, but the difference between competences can be too large. Even though the added tool could benefit customers, not every organization can be integrated. Interviews revealed that there are several, technical similar, business areas that Synopsys choose to ignore, because the organizational gaps are too large, e.g. the automotive industry (INTV 6, 2013). Here the technological competences might be complementary, but the area of business much different. This has resulted in Synopsys' strategy to only acquire business that has similar legal-, business- and sales-operations (ibid.). Thus, further limiting their innovative capabilities.

The competence-dependent and fast development phase places greater emphasis on Synopsys capacity to contain and use the acquired knowledge. This is especially important since the real value is not just in the ability to sell a given technology in a new bundle ( INTV 3, 2013; INTV 1, 2013). The literature review revealed that a high absorptive capacity of competences will rely on similarity in knowledge domains, e.g. Cassiman and Veugelers (2006). As seen in section 5.3, with the integration of ViewLogic's complementary products and technologies brought an effective absorption ( INTV 3, 2013). Many of Synopsys's less successful acquisitions have focused on access to technologies or introducing new business areas to the company ( INTV 2, 2013). So even though acquisitions have to fit legal-, business- and sales-requirements, as emphasized in section 6.4.5, there has to be enough difference in the technologies to avoid internal competition ( INTV 6, 2013). Hence, acquired competences and technology should be similar with regards to legal-, business- and sales- requirements, but show some difference in technology and have complementary value to customers. This is an area important to EDA-innovation, but largely untouched by the existing literature.

Looking at Synopsys innovational effort, it seem clear that combined knowledge allows production of high-quality inventions in equivalent technology areas of the acquiring company, as described by Fleming (2001). Hence, Synopsys is able to broaden their technology portfolio through acquisitions ( INTV 3, 2013). While knowledge similarity between Synopsys and the acquired company enhances exploitation, knowledge complementaries also facilitate a process of exploration through experimentation with new competencies and technologies, as desired by March (1991). Moreover, knowledge redundancy diminishes the opportunities for creating radically new knowledge and is therefore not likely to produce exploratory innovation (March, 1991). With similarities, exploitative R&D is emphasized to the exclusion of exploratory learning. These arguments suggest that knowledge similarities are less likely to contribute to a radically different invention at Synopsys (Fleming, 2001). This may be because path dependencies play an important role in technology-motivated acquisitions. Makri, Hitt, and Lane (2010) showed that knowledge similarities had no effect on invention quantity or quality, but had a negative effect on invention novelty, and this seems especially true considering Synopsys products. These findings support the notion of path dependencies. So when Synopsys acquires a company with similar technologies it has a high relative absorptive capacity that facilitates integration of innovation capabilities, but also makes innovation even more incremental.

### 6.3.2 Complementary - similarity and differences

When Synopsys evaluates acquisition targets, a balance must be held in the complementarity of new acquired competences ( INTV 3, 2013).Acqusition targets has to do something better or different than Synopsys to be relavent. Synopsys maintains this balance if the competences are similar, but with too much similarity, the technological motivation of the acquisition will be gone ( INTV 3, 2013; INTV 1, 2013). Consistent with the findings of Makri et al (2010), Synopsys acqusition of ChipIt may have secured competences, but to a product that was inferior to another Synopsys product (INTV 6, 2013). On the other hand, research shows that more similar companies' technological knowledge, have quicker process assimilation and can thus be commercially exploited earlier (Cohen and Levinthal, 1990). This makes it important for Synopsys to acquire relatively close to their core competences, as it is seen with successful acquisition of Springsoft (2012).

*"With Springsoft, we developed a clear plan for how to sell their products before the integration was even finished."*
*- INTV 6 (2013)*

The interviews revealed that an effective way to evaluate complementaries was technological roadmaps ( INTV 3, 2013; INTV 2, 2013; INTV 1, 2013). Technological roadmaps can simply be consulted to gain knowledge of which technologies are needed at what time, and possible acquisition can be evaluated.

Based on section 5.3 it is apparent that 42 out 46 acquisitions provided Synopsys with technologies complementary to their existing product portfolio. In line with the statements from the interviews, supporting that acquisition of complementary technologies is at focus in the evaluation of potential acquisition targets ( INTV 2, 2013; INTV 6, 2013). However, the value obtained from these acquisitions may, to some extent, be questioned, as the companies are operating within the same industry, resulting in high external relatedness

(INTV 6, 2013; Homburg and Bucerius 2006).

As exemplified by the ChipIt and Magma acquisitions, which entailed high similarity in technological and scientific knowledge ( INTV 6, 2013; INTV 2, 2013; Makri et al., 2010). In fact, the entire ChipIt product portfolio was dropped, however the similarity in technological knowledge is used to developed solutions complementary to the HAPS FPGA platform ( INTV 2, 2013; INTV 6, 2013).

*"The ChipIt acquisition looked good on paper, but it did not bring any value. The research was not done properly prior to the acquisition."*
*- INTV 2 (2013)*

Thus, implying incremental, rather than radical change, potentially eroding the post-acquisition performance, consistent with Makri et al. (2010).

From section 5.3 it is apparent that most of Synopsys acquisitions are within complementary fields, and the development process is very similar, even though the finished technology differs ( INTV 1, 2013). When Synopsys and the acquired companies have knowledge complementaries, they have common knowledge stocks, and this facilitates communication and coordination between the merging companies (Cassiman et al., 2005; Makri, et al., 2010). Hence, acquisitions will improve innovation when the technological knowledge is similar enough to facilitate learning, but different enough to provide both new opportunities and the incentives to explore them. Common knowledge enhances both companies understanding of the complementary competences consistent with the results of Cassiman et al., (2005). These conditions facilitate the integration of their complementary knowledge stocks in the merged company, thereby contributing to increased invention productivity.

### 6.3.3 When quality is paramount

In the production of ICs, the chip production has very high start-up costs, and because of that it is incredibly important to have flawless design software. Therefore, it is important to have verification tool, which ensures that only flawless productions are initiated ( INTV 2, 2013). As, a standard microprocessor line will have a material start-up cost of over $50.000.000 (INTV 4, 2012). This place great emphasis on design and therefore Synopsys is only interested in technology that grants them access to complementary products categories with the market potential of being technological superior in the industry ( INTV 2, 2013). Hence, an acquisition innovation strategy is valid since companies' can acquire complementary science and technology knowledge to produce higher quality and more novel inventions, consistent with Makri, et al (2010). Thus, Synopsys increases R&D performance by acquiring the best engineering talents with complementary science and technology knowledge in different fields as these talents as individuals bring different *Human Capital,* which creates new organizational capabilities (Felin, et al., 2012; INTV 3, 2013).

*"The best R&D does not at all happen in any one company. "*
*- INTV 3 (2013)*

Thus, acknowledging that relying solely on internal R&D activities reduces the innovation, decreases the development speed and results in more complex, risky and costly R&D projects as supported by Kleer and Wagner's (2007) findings. Complementaries in the acquiring and acquired companies' science and technology domains are positively related to invention quantity in similar technology domains after the acquisition ( INTV 3, 2013). Therefore, Synopsys has mainly been acquiring companies within the EDA industry and with technologies complementary to their own ( INTV 3, 2013). Hence, acquiring competing companies with the best complementary competences and technology is a way to get the best engineers.

*"Acquired companies have been working on the same type of problems as we are working on. They*

*have just taken another approach, which may have been more successful. Complementary to what we are doing."*
*- INTV 3 (2013)*

The section has covered the importance of ensuring high quality in the software being developed.

### 6.3.4 The importance of similar culture

This sections focuses on the strategic importance of acquiring companies with similar culture and complementary capabilities. Synopsys is focusing on acquiring companies with similar company culture and complementary capabilities ( INTV 3, 2013). Thus, aiming at acquiring companies with high internal relatedness to Synopsys ( INTV 3, 2013; Homburg and Bucerius 2006).

*"We look to acquire companies, which have a imilar culture, which is, driving innovation and customer focus."*
*-INTV 3 (2013)*

In order to be working in or more importantly managing a company in the EDA industry, within other areas than finance and HR, it is important to have a background in hard- or software engineering (INTV 6, 2013). Similarity in the educational background would have ensured a better management of the assets in Company 1 (INTV 1, 2013). Hence, the similarity in managerial knowledge is important to successful management in Synopsys ( INTV 3, 2013; INTV 6, 2013). Contradictory to the notion stressed by the theoretical research that similarity in top management has decreasing effects on the integration performance (Krishnan et al., 1997). Thus, similarity in routines makes it easier to ensure, effective managerial processes enabling adaptation of new competences (Felin et al., 2012) .

### 6.3.5 Summarizing complementarity

Based on the analysis of how complementarity and similarity influence acquisitions, it can be argued that the acquired technological capabilities and complementary knowledge increased invention quality in Synopsys, consistent with prior research. Looking at acquisitions in the EDA industry from a Synopsys focal point, related EDA acquisitions with complementary technologies are ignored due to the organizational gaps, an interesting avenue untouched by existing literature. The analysis found the real value creation to esteem for the further development of the acquired technology utilizing the acquired technological capabilities. Thus, in line with theory, integration is important to leverage the real value of the acquired competences to develop next generation software. Moreover, one of the dangers of Synopsys acquisition history, based on this analysis, is the high external relatedness and incremental change, which may erode the post-acquisition performance of the company, consistent with the finding of existing research in the field. Moreover, partly in line with the notion of other researchers the analysis found that acquisition performance is increased through an appropriate level of similarity in technological knowledge.

In accordance with existing research, relying only on internal R&D decreases speed and innovation levels and increases risk. These findings indicate that Synopsys has been able to increase R&D performance by acquiring the best talents with complementary science and technology knowledge consistent with the findings of existing literature.

As it was found in the previous section, the executive management of Synopsys has been very stable and based on the analysis in can be similar knowledge is foundt to be important. Thus, contradictory to existing research, similarity in managerial knowledge in the top management is important for successful integration. This section has focused on the importance of complementarity resources. The following section analyses *innovation performance* in relation to acquisition.

## 6.4 Innovation performance

From the literature review it can be deducted that innovative skills and competences can be acquired, if the effort is well managed (E.g. Hitt et al., 2001), but that enhancing Innovation Performance via technological acquisition is a complex process (E.g. Ahuja and Katila, 2001). Consistent with Kleer and Wagner (2012) the research data showed that Synopsys is a large and dominant acquirer within the EDA industry (Section 5.3; INTV 3, 2013; INTV 2, 2013). This section will analyze how technological acquisitions enhance innovation at Synopsys by answering the following sub-question: *How can competence-based acquisitions enhance overall innovation performance?*

### 6.4.1 Make or buy

Our literature review has established that technological acquisitions enhance *Innovation performance* in the acquiring company (Ahuja and Katila, 2001; Haspeslagh and Jemison, 1991). At Synopsys this can be seen in the way they expand the knowledge base and gain economy of scale and scope, since a lot of non R&D efforts and administrative expenses can be rationalized after an acquisition ( INTV 3, 2013). Looking at Synopsys acquisition history, 93,47% of the past 19 years of acquisitions have been fully integrated into the main organization, resulting in major expense cuts (cf. section 5.3) but even though rationalizing operations will save resources, this is not the main reason behind Synopsys acquisitions ( INTV 3, 2013).

Consistent with Haspeslagh and Jemison (1991), this thesis found that the largest value creation happens in the post-merger recombination benefits ( INTV 3, 2013). Acquired technologies can be integrated into a larger portfolio of tools, which makes them more efficient to market and sell ( INTV 2, 2013). Prior research indicates that internal innovation entails a higher risk compared to that of external innovation (Hitt et al., 2001). This aligns with Synopsys overall vision of supplying a comprehensive software suite, with all required EDA-tools (Synopsys, 2012 a). Most importantly, acquired competences in *Human Capital* constitute the real value, since this secures the next version of the product ( INTV 1, 2013), as found in section 6.3.1. This is extremely important due to the fast development in the industry. R&D can benefit from knowledge sharing and a rationalization (Ahuja and Katila, 2001; INTV 3, 2013). By buying and collecting already working R&D teams, into a network of semi-independent actors, there can also be significant potential for inventive recombination, consistent with prior research ( INTV 3, 2013; Fleming, 2001). By having internal structures enabling efficient coordination of both acquired and existing capabilities (Felin et al., 2012) .

*"(...) If you can get the best R&D it is going to pay off no matter the costs. (...) In this industry it is about people."*
*- INTV 3 (2013)*

Technological acquisitions can also entail a disruption in organizational routines (Ahuja and Katila, 2001). At Synopsys this disruption is countered by a very strong culture, which is installed in every part of the organization ( INTV 3, 2013). Hence, even though R&D is closest to the innovations, this does not seems to be a problem since acquired companies has similar culture amongst engineers ( INTV 1, 2013; INTV 2, 2013). This result in the benefits of acquisitions and outweighs their negative effects on organizational routines (Haspeslagh and Jemison, 1991). This section identified that the value creation takes place in the integration process.

### 6.4.2 Internal R&D and external innovation through acquisitions

This part of the analysis covers the effects of having a mix of internal R&D and external innovation through acquisitions. Synopsys does not only engage in innovation through acquisitions. Approximately 1/3 of the Synopsys overall revenue is reinvested into R&D activities (Synopsys, 2012 b). The majority of these investments comes from sales of the core products, the company's cash cows ( INTV 2, 2013; INTV 3, 2013). This innovation effort is very incremental because of the industry's dependence on industry wide technological roadmaps ( INTV 3, 2013). This is analyzed in section 7.5.

*"The backbone in the company, the synthesis tools, is maintained primarily through internal R&D. The acquisitions build on to this backbone"*
*- INTV 2 (2013)*

Synopsys internal R&D activities are focusing on exploiting existing knowledge to create incremental innovation on existing core products ( INTV 2, 2013). Hence, the core EDA-business is funding acquisition outside this main business area, and is driven by internal R&D activities, whereas complementary and new business areas are acquired. This relates to the results found by Cassiman and Veugelers (2006), because of the strategic mix of internal R&D and external knowledge-acquisition. At Synopsys, the fundamental R&D in Logic Synthesis fuels the overall innovation, and every other tool is placed adjacent to that ( INTV 3, 2013; INTV 6, 2013). Prior research does not seem to cover the division between core R&D and competence and technology acquisition. Hence, Synopsys' seemingly successful division of core EDA R&D and adjacent knowledge acquisition have only been covered partially by academic research. Thus, Internal R&D can create the "right context" for acquired technologies partially confirming the findings by Cassiman and Veugelers (2006). As the right processes enables the development of new competences though collective actions (Felin et al., 2012) .

### 6.4.3 Integration strategies: absorption and preservation

Depending on the complementarity of the acquired company's product portfolio, as well as the goodwill of the acquired brand, an appropriate integration strategy is chosen ( INTV 3, 2013). Consistent with prior research, Synopsys use an *absorption strategy* for the acquired companies' with complementary product portfolio, entailing a relatively fast integration following the milestones listed in the section on Integration Process ( INTV 3, 2013; Haspeslagh and Jemison, 1991). Hence, when product technologies fit, the acquired company's knowledge base is integrated into Synopsys' knowledge base in an absorption acquisition, as recommended by Haspeslagh and Jemison (1991).

*"If there is a large overlap in products, they get merged into the existing organization."*
*- INTV(2013)*

Such a union can potentially expand Synopsys knowledge base and increase its innovation output, by utilizing the knowledge more broadly. The absolute size of the acquired knowledge base also has a positive impact on innovation output. In the recent acquisition of SpringSoft, the integration process was very smooth due to the strategic *Technological fit* as well as the well-established integration process based on prior experience (INTV 6, 2013). Enabling the sales staff to prepare customers even before the acquisition was official, as the time line of the integration is following a well-established time line (ibid.). Thus, Synopsys is able to successfully apply a standard time line to *absorption* acquisitions, partially contradictory to findings of Muehlfeld et al., (2012), who found performance to be negatively influenced by generalized recommendations based on prior experience for different contexts. When the acquired company processes unique products Synopsys utilize a *preservation* approach ( INTV 3, 2013; Haspeslagh and Jemison, 1991). This grants the acquired company autonomy to operate and gives Synopsys time to identify complementary resources and key employees ( INTV 3, 2013; Haspeslagh and Jemison, 1991).

*"If they have a product that is unique, then it is like that the organization will remain intact by report to one of the existing business units."*
*-INTV 3 (2013)*

This is followed by a gradual increase in the interdependency between the two organizations (ibid.). Where the interactions between individuals of the two organizations create new capabilities (Felin et al., 2012) . A symbiosis approach, initiated by preservation was used in the integration of Optical Research Associates in 2010, as the company was operating within an adjacent industry to the EDA industry ( INTV 3, 2013). More importantly, Optical Research Associates is a well-known brand within their industry (ibid.). Therefore the organization was kept intact and slowly integrated into Synopsys follows a symbiosis integration strategy, (Haspeslagh and Jemison,1991; INTV 3, 2013).

*"In a case like that it is important to maintain the brand for quite a while because that brand has very high value in the customer space."*
*- INTV 3 (2013)*

In line with the finding of Puranam et al., (2006) Synopsys is able to balance the exploitation of their capabilities and technologies in a coordinated way, and foster their exploration capacity by preserving their autonomy in the acquisitions where it is needed.

### 6.4.4 How innovative competences can be acquired

When technology is acquired, the knowledge behind is not easy to transfer, partly because of the tacitness of the competences (Bresman, et al. 1999). Synopsys acquisitions seem to avoid high transaction costs, because acquired technology and employees are integrated altogether and have a cognitive overlap in knowledge ( INTV 3, 2013; INTV 2, 2013). This seems to solve problems related to the transmission of knowledge that would otherwise appear, consistent with Bresman, et al.(1999) and Larsson, et al. (1998). This enables Synopsys to tackle larger R&D and more complex research-projects than each individual company could have done, since a larger base of knowledge can be combined in research ( INTV 3, 2013; INTV 2, 2013). By buying complementary knowledge Synopsys can combine specific strengths and develop new technologies or products that each partner on its own would not have been able to create (INTV 6, 2013; INTV 3, 2013; INTV 2, 2013). Thus, consistent with suggestions from Makri et al. (2001), high tech companies should acquire targets with complementary technical and scientific knowledge. This may have two effects: either an innovation emerges which would not have been possible without the collaboration or an innovation is realized much faster than when the partners would not have collaborated (INTV 6, 2013; INTV 3, 2013).

*"IC is a unique field because it moves so fast. It is an absolute necessity to innovate and advance in R&D."*
*- INTV 3 (2013)*

Thus, confirming the findings by Hitt et al., (2001) that company's such as Synopsys need to have a continuous emphasis on maintaining and enhancing innovation as a part of a focused acquisition strategy in order to stay competitive.

As it was found in section 6.3.1, in the Cascade Inc. acquisition in 2004, the real value creation came from the further development and innovations the acquired engineers produced (Esteve, 2013). Thus, consistent with the prior research, knowledge and innovative capabilities can be acquired and successfully integrated (Hitt et. al , 2001). This was possible because of the similarity between Synopsys and the acquired company. Larger similarity seems to correlate with successful post-merger innovation, and process of integration at Synopsys ( INTV 3, 2013). This part of the analysis has shed light on how innovative competences can be acquired.

### 6.4.5 What to acquire?

The following section explores how Synopsys identifies which companies to acquire. When choosing which companies to acquire, it was found that Synopsys are aiming their acquisition efforts at targets with related company culture and complementary technologies ( INTV 3, 2013).

*"We look for companies that have successful engineering capabilities that they have delivered to the market. We may not have developed that capability or we may not have successfully developed that capability and it will be a good fit into our offerings place. "*
*- INTV 3 (2013)*

Thus, the acquisitions of proven innovation reduces risk and decrease the time to market for Synopsys, consistent with the findings of Hitt et al., (2001).

Moreover, Homburg and Bucerius (2006) found that high levels of relatedness in terms of strategy, norms and business model increased the post integration performance. Looking at Synopsys, it seems that the internal relatedness of acquired and acquiring knowledge bases correlates with innovation output, consistent with Homburg and Bucerius (2006). Contrarily to theory, however, Synopsys seem to acquire companies with a high external relatedness as well. Acquired companies often shares target markets and market positioning. Therefore acquired companies may not gain much new in acquisition, other than technology and competences.

Synopsys' acquisitions are not conducted to increase the market share by acquiring customer base, nor do Synopsys acquire companies to purely prevent competitors from getting access to the capabilities a given company possess ( INTV 3, 2013). So apart from internally similar companies, Synopsys are looking to acquire compementary technologies and the competences behind. Thus, consistent with theoretical findings, the due diligence evaluation is based on financial measures, technological and scientific knowledge stocks (Makri et. al. 2001).

Our interview revealed that business, legal and sales terms of possible acquisitions has to be similar to the ones in Synopsys (INTV 6, 2013).

*"The companies we acquire have to fit into our legal terms, business terms and sales terms."*
*- INTV 6 (2013)*

Synopsys does not only acquire design technologies. As is evident from section 5.1.3.2, about 25% of Synopsys total revenue came from IP blocks, as many of the components of big SoC chips are standardized. Acquisitions like the 2012's "MoSys" "Inventure" and 2010 "Viralogic" (see section 5.3 for analysis) are examples of Synopsys acquiring designed IP-building blocks, and not design software. This falls outside Synopsys EDA-business, but are very complementary to EDA-software.

*"There is not value added for the customers to invent their own USB-module, as the function is completely standardized."*
*-INTV (2013)*

The size of the company is important to Synopsys. However, when entering new industries and markets segments Synopsys has a clear strategy of becoming the industry leader ( INTV 2, 2013). Contradictory to the findings of Puranam et al., (2003) Synopsys has been able to successfully increase their Innovation Performance through acquisitions of small companies in adjacent markets ( INTV 3, 2013).

The aforementioned acquisition of Optical Research Associates is an example of a small company providing a high level of new knowledge to Synopsys, increasing their Innovation Performance (ibid.).

Thus, Synopsys is focusing on acquiring specific technology with scientific and technological knowledge complementary to their own, increasing novelty and the quality of innovations consistent with the findings of Makri et al., (2010).

### 6.4.6 Summarizing innovation performance

This section aimed to identify, which effects acquisitions can have on innovation performance. Several aspects leading to increased Innovation Performance are uncovered as well as other related aspects. First, technological acquisitions were found to enhance innovation performance. Moreover, Logic Synthesis was found to create a backbone, continuously improved through internal R&D and expanded through acquired technologies. Thus, partially covered by existing literature, internal R&D can create the "right context" for acquired technologies.

In the integration phase, Synopsys was found to primarily apply two types of integration approaches; *absorption* and *preservation*. Consistent with existing research, Synopsys use an absorption strategy when acquired companies, which have complementary product portfolio and uses a preservation strategy when acquired companies possessing unique products. Based on their experience with many absorption acquisitions Synopsys has been able to successfully develop standardized time lines for the integration process, contradictory to the findings for prior research. When identifying targets, Synopsys was found to focus on acquiring targets with complementary technical and scientific knowledge in line with existing research, as this increase innovation performance. Moreover, Haspeslagh and Jemison's (1991) notion that different integration strategies can be utilized, and that innovation is more effective when the companies involved have an overlap in knowledge, is confirmed. The analysis finds that securing development competences is central, since the software is being developed fast. *Secondly*, congruent with literature, Synopsys need to have a continuous emphasis on maintaining and enhanceing innovation as part of a focused acquisition strategy in order to stay competitive. Synopsys uses acquisitions to get a hold of new brake though innovation in adjacent market segments within, as well as outside, the EDA industry. As found in the previous section, similarity seems to correlate with successful post-merger innovation performance. In line with the previous findings in the section regarding Human Capital, which found the focus not to be on the acquired leaders, rather Synopsys focused on acquiring only competences and technology ,an aspect untouched by existing literature. High internal relatedness is important for Synopsys to utilize the effects of economy of scale. Consistent with prior research acquired companies should have high internal, and low external, relatedness. The due diligence evaluation is based on financial measure, technological and scientific knowledge stocks, in line with foregoing theory.

Contradictory to relevant academic research, Synopsys has been able to increase Innovation Performance through acquisition of small companies. Moreover, in accordance with literature, innovation performance was found to positively affect complementary technological and scientific knowledge. Based on the analysis the acquisitions of proven innovation reduce risk and decrease the time to market for the acquiring company.

The following section will analyze ecosystems, technological roadmaps and their effect on the post acquisition performance.

## 6.5 Technological Fit

The literature review has presented academic results suggesting that high tech innovation can be driven by acquisitions (e.g. Hitt et al, 2001). Synopsys is a fine example given that, outside Synopsys core business (logic synthesis), strategic acquisition is almost exclusively used in the development, even though the company is experienced in internal R&D (see section 6.4.2). This section analyzes Synopsys acquisitions Technological Fit. First, the business ecosystem analogy is utilized to understand the use of technological roadmaps and development, and then link this back to an analysis of Synopsys acquisition-driven innovation strategy. This strategic view will show how Synopsys can use acquisition to balance exploration and exploitation in a fast changing industry. Thus, this section aims to answer the following sub question: H*ow can ecosystems and technological roadmaps enhance competence-based acquisitions?*

### 6.5.1 Ecosystems and technological roadmaps

This section shed light on the role of *ecosystems* and technological roadmaps and their effects on acquisitions. A key to Synopsys' successful acquisitions seems to be aligned to the IC-industry environment. If the acquisition fits perfectly into Synopsys portfolio, present and future product technologies can create more value in Synopsys' portfolio, that as standalone software, because Synopsys is well integrated into the industry ( INTV 3, 2013; INTV 6, 2013). This is consistent with the findings of Meyer and Kenny (2004), who found business ecosystems to enable such effective high tech development and acquisition strategies.

*"One of the cornerstones of how we do business is the ecosystem."*
*- INTV 3 (2013)*

The IC-industry functions as biological ecosystem because the many loosely interconnected companies are specialized and independent, but are still interdependent for mutual effectiveness and survival (Iansiti and Levien, 2004; INTV 3, 2013). Synopsys' strategy seems to be very affected by this analogy, since their strategy always focus on their placement in the network (Iansiti and Levien, 2004; INTV 3, 2013; INTV 6, 2013). With most of Synopsys employees having a natural scientific background (even management (Synopsys, 2012 a)), this view seemed very natural and logical to all the Synopsys engineers, which were interviewed, even though the ecosystem approach contrasts from most classic managerial perspectives (Iansiti and Levien, 2004; INTV 3, 2013). This causes Synopsys to position the company's strategy to further its own interests by promoting its overall ecosystem (industry) health. This is consistent with Synopsys' vision to evolve the IC-industry as clusters of networked companies ( INTV 3, 2013; Synopsys, 2012 a).

The theoretical framework of business ecosystems consist of three classes of companies: dominators, niche players and a keystone business in the middle. In the IC-industry, Intel[2] acts as a *Principle keystone* by creating an environment where many smaller niche business can differentiate and complement Intel's core technologies (Iansiti and Levien, 2004; INTV 3, 2013; INTV 2, 2013). Intel acts to improve the overall health of the ecosystem by creating and sharing value with this network, and by leveraging its central hub position while not occupying much of the network (Iansiti and Levien, 2004; INTV 3, 2013). Synopsys, as an EDA-provider, acts as a niche player, and this means focusing on unique capabilities and leveraging key assets provided by others. Synopsys does this by focusing on EDA and related technologies, while relying on other industry players to do their critical work ( INTV 3, 2013). There can be no EDA without the IC-industry and vice-versa ( INTV 3, 2013; INTV 2, 2013).

With the business ecosystem in place, every industry actor will be able to compete for a critical role, and create value (Iansiti and Levien, 2004). In the IC-industry this is supported by technological roadmaps.

2 http://www.intel.com/content/www/us/en/company-overview/company-overview.html

Technological roadmaps are used to facilitate a more unified technological development of different companies, while still maintaining competition between the individual industry actors (Miller and O'Leary, 2007).

*"Synopsys and the rest of the industry generally follow Moore's Law as a roadmap for the development of software and IC."*
*-INTV 3 (2013)*

The technological roadmaps sets the direction in which the industry is moving, but are developed commonly. For Synopsys this means an added information flow of their customers and collaborators in the market. Hence, Synopsys is heavily dependent on industry roadmaps to innovate ( INTV 3, 2013). However, this is not an exclusive benefit for Synopsys. Technological roadmaps also provide basic research for the competitors, but do not facilitate free flow of knowledge between competitors in the industry (Miller and O'Leary, 2007). Hereby, the industry is very competitive, in what could be called an open network of industry, with closed innovation actors.

For Synopsys, technological roadmaps can provide valuable insights into the development of the industry and act as a coordinating agent linking technologies, products, and markets ( INTV 3, 2013). Consistent with Mayer and Kenny (2004) this has several implications for Synopsys. Concerning acquisitions the ecosystem roadmaps is making it possible for Synopsys to identify companies with complementary technologies and knowledge ( INTV 3, 2013; INTV 1, 2013; INTV 2, 2013). Hence, the technological roadmaps enable Synopsys ecosystem strategy with symbiosis opportunities between different product generations and technologies.

*"The roadmaps gives us a general idea of where the technology is headed, when it will get there, and what the challenges are."*
*-INTV 3 (2013)*

With the ecosystems and technological roadmaps, Synopsys know which technology to acquire and integrate, rather than focusing primarily on their internal capabilities, they emphasize the collective properties of the business networks in which they participate, and treat these more like organic ecosystems than traditional supply chain partners ( INTV 3, 2013). The interviews indicate that this have enabled Synopsys to develop a scalable business model with acquisitions. Hence, the ecological enhanced roadmaps enable the company to meet the challenges posed by continued business expansion, rapid development, and technological roadmaps act as structures increasing the coordination of the collective actions in Synopsys (Felin et al., 2012; INTV 3, 2013; INTV 2, 2013; INTV 1, 2013).

Synopsys links together supply chain partners into a network based on practices and technology of the Internet ( INTV 3, 2013). This approach is not only ecological within their industry, but links customers, employees, contractors etc. to the ecosystem, through Synopsys, because Synopsys know what the system needs externally through the technological roadmaps ( INTV 3, 2013). Hence, Synopsys relies on a complex network of external assets and has moved to directly gain assets through acquisitions. These ecosystem driven acquisitions, which enables Synopsys to offer the ecosystem a comprehensive soft- and hard-ware solution with everything needed for EDA operations ( INTV 1, 2013; INTV 3, 2013). Thus, creating acquisition alignment with industry needs, consistent with existing research (Garcia and Bray, 1997; Mayer and Kenney, 2004; Ahuja and Katila, 2001). The ecosystem approach specifies the evolutionary competition of smaller organisms, that can be integrated into larger, and then survive and grow, leaving other smaller organism behind (Iansiti and Levien, 2004). For industry level roadmaps, this enables the industry to coordinate and specialize, not by chance, but because of planning and competition in the niches (Garcia and Bray, 1997; Mayer and Kenney, 2004; INTV 3, 2013). In the same way, Synopsys are able only to acquire needed and proven technology, and if successful retain competences, to enhance their own contribution to the ecosystem ( INTV 3, 2013).

The technological roadmaps and ecosystem therefore enable better technology investments at an industry level, by giving actors the ability to forecast and coordinate technology developments (Iansiti and Levien, 2004; INTV 3, 2013; INTV 2, 2013).

### 6.5.2 The technological roadmaping process

The following analysis covers the development process in technological roadmapping. In the IC industry Intel has a central position (INTV 6, 2013; INTV 3, 2013). In the technological roadmapping process (see Figure 4), they often do the *Preliminary Activity*, and take care of the development and follow up, in corporation with other industry. This results in technological roadmaps (e.g. Intel technological roadmaps 2012[3] or Intel 22 nm Transistor technological roadmaps[4] ). This enables the ecological ecosystem to grow around the roadmaps, and different companies to specialize in specific parts of the development (Iansiti and Levien, 2004; INTV 3, 2013). For Synopsys, this result in relatively precise descriptions of technology needed to be developed, and, hence, also process a classification of the competence needed. This enables Synopsys to secure assets with great precision.

*"The roadmaps tell us what to develop and where we are heading, therefore it is absolutely key to have good road mapping."*
*- INTV 3 (2013)*

Thus, confirming exiting theory, which found roadmapping that can provide a mechanism to help experts forecast technology developments in targeted areas (Garcia and Bray, 1997; MacMillen et al., 2000).

3 http://www.intel.com/content/dam/www/public/us/en/documents/best-practices/peek-at-the-future-rick-white-presentation.pdf
4 http://download.intel.com/newsroom/kits/22nm/pdfs/22nm-Details_Presentation.pdf

### 6.5.3 Technology roadmaps at an industry level

Synopsys follows the specific and contemporary roadmaps, provided by the international technological roadmaps for ICs and SIA's IC technological roadmaps ( INTV 3, 2013). This provides Synopsys with knowledge of marked's needs (ibid.). Thus, consistent with existing research, technological roadmaps enable industry players such as Synopsys to identify companies with complementary technologies and knowledge and thereby making better technological investments (Rinne, 2004; Miller and O'Leary, 2007; Garcia and Bray, 1997). These roadmaps are developed by representative experts, and gives directions 15 years into the future (ITRS, 2010). For Synopsys this provides a means for collaboration with other industry actors and enables the synchronization of goals and information (Miller and O'Leary, 2007; INTV 3, 2013). Hence, Synopsys gain from the existence of roadmaps, because they provide clear direction for technological development, but also because Synopsys' roadmaps provide vital information about their customers, as Synopsys create value by facilitating IC-producers and customers to design ICs. Becuase technological roadmaps makes strategizing much more efficient, because it provides not only current, but also future market information (Miller and O'Leary, 2007; INTV 3, 2013). Thus, enabling *processes* easing the adaptation of new technologies (Felin et al., 2012) .

The success of Synopsys depends on the ability to predict the technological development. Hence, Synopsys could not only predict what technological features the software should be able to handle, but also what customers would need the software to do ( INTV 3, 2013). Hereby, Synopsys can plan investments and development after a specific time line that is available to everyone. The backside to this is that the time line has to be met, and that other competitors can get there as well.

*"The ITRS provides some basic shared research and perimeters for competition that make the industry collaborate to the benefit of all stakeholders."*
*- INTV 3 (2013)*

Synopsys is following industry guidelines in all their development projects and Synopsys rely heavily on external innovation and knowledge production ( INTV 3, 2013). This happens through roadmapping( INTV 3, 2013).

## 6.5.4 Technology roadmaps at a corporate level

This analysis covers how Synopsys use roadmaps at a corporate level. For Synopsys, the value of corporate technological roadmaps lays in the enhancement of technology planning, technology selection, and technological innovation ( INTV 3, 2013; INTV 1, 2013; INTV 6, 2013). Corporate-level Roadmaps are created within Synopsys and are not necessary public to other industry players ( INTV 1, 2013). They contain primarily Synopsys technology, but are sometimes created and shared with partners. Planning and selection of technological is essential, since the development is carried out by many departments globally. The roadmaps are used as a planning tool incorporating the all-important environment, and hence facilitating the *Technological Fit* ( INTV 3, 2013; INTV 6, 2013). On the other hand, the corporate roadmaps also facilitate the selection of technologies, as several possible acquirable technologies might have a different solution to the same problem. Here the Roadmaps works as a guide to the overall ecological fit in the acquisition.

Synopsys own technological roadmaps are specific oriented towards products technologies, but follow industry-level roadmaps ( INTV 3, 2013). They enable Synopsys to follow the overall business ecology and participate with its own technology standards, such as the HAPS interfaces, that have become industry standards ( INTV 3, 2013; INTV 1, 2013). So overall, the corporate roadmaps in Synopsys help the ecosystem players to be independent, and yet they co-evolve with Synopsys roadmaps. Were acquisition strategies usually fail to synergies the different cultures and organizations, Synopsys roadmaps also have a non-technological benefit. They play an important part in maintaining the culture and human resources of its acquired companies, because they provide clear mission and goals to development engineers ( INTV 1, 2013).

*"We engage the customers of the acquired companies in the development of the corporate level road maps through road shows, to find out which products solution to continue to support and how customers move to this solution."*
*- INTV 6 (2013)*

Hence, Synopsys corporate roadmaps do not only benefit technological purposes, but also plays an integration role in connecting all members to a new technology portfolio.

## 6.5.5 Exploitation and exploration

The integration cost of software is lower than the cost of integration of physical or organizational assets, which simplifies EDA acquisitions ( INTV 2, 2013). The literature review found this to be one of the key factors that enable companies to increase the novelty and quality of their innovations through acquisitions, because complementary technical and scientific knowledge increase post-acquisition R&D performance (Makri, Hitt, and Lane, 2010). Thus, easing the pre-acquisition search process and enabling a better application of the acquired capabilities. However this required the right strategy investment, as Synopsys have strong competition.

*"The essence of exploitation is the refinement and extension of existing competencies, technologies, and paradigms. The essence of exploration is experimentation with new alternatives."*
*- March, 1991: 85*

According to March (1991) every company can simultaneously balance exploration and exploitation across domains. Synopsys acquisition strategy across technological structure and domains enables Synopsys to access potentially new knowledge bases while reducing the risk of unfamiliarity and leveraging prior experience ( INTV 6, 2013). Hence, Synopsys acts as adaptive systems in a state of equilibrium between exploration and exploitation. Synopsys emphasize a mix of explorations and exploitations in their acquisitions, so across domains, and time, balance is maintained ( INTV 3, 2013). Whereas many previous acqusitions have focused on exploitation, recent acqusitions has mainly focused on exploration, as Synomys had to more into adjacent industries to find suitable targets due to the consolidation of the EDA industry ( INTV 6, 2013). The acqusition of Optical Research Associates mark the entry into markets adjacent to the EDA industry, and the need for a different integration approach, as the executives had little expertise within this market and customers did not know Synopsys ( INTV 3, 2013).

*"In that space people do not know who Synopsys is, and what our reputation is, and they could have strong concerns that we will not manage the company well."*
*-INTV 3 (2013)*

From section 6.4.3, it was apparent that a symbiosis approach, is applied to ensure autonomy and slowly leverage the capacity of the company to create new sources of innovation (Haspeslagh and Jemison, 1991; Puranam and Srikanth, 2007). The focus on new sources of innovation is also underlined by the findings in the analysis of the Synopsys' acquisitions, as the Optical Research Associates acqusition is categorized as a *domain exploration* where general management skills and experience from the EDA industry is utilized to create rapid development (Haspeslagh and Jemison, 1991; INTV 3, 2013).

*"Adaptation requires both exploitation and exploration to achieve persistent success"*
*- Haspeslagh and Jemison, 1991:205*

Based on the analysis in section 5.3 it can be argued that Synopsys has been able to utilize both exploitation and exploration through its many domain-extending acquisitions. By recognizing the evolutionary dynamics and multiple facets of exploration and exploitation Synopsys should be able to balance exploration and exploitation and avoid polar temporal tendencies to explore or exploit in certain domains. This help Synopsys use the acquired company's existing knowledge as an input to their own innovation processes.

As new competences arise from the interactions of individuals in the organization (Felin et al., 2012) .

*"Managers should form clear ideas regarding whether the potential for future innovation is likely to be derived from leveraging capacity or knowledge."*
*- Puranam and Srikanth, 2007, s. 821*

Contrary to this, but in line with the literature, interviews also showed that this hinders the acquired company as an independent source of on-going innovation, as routines were changed and a new and more bureaucratic culture installed ( INTV 3, 2013; Puranam and Srikanth, 2007). This means that acqusition might give short term innovation, but may not provide future innovational competences (ibid.). Reducing the R&D of the acquired companies may have severe implications for future performance ( INTV 1, 2013).

*"Now we can cut back on the development, now we are home free. (…) Relaxing too much and going into a mode where you think now it is safe, that is dangerous."*
*- INTV 1, 2013*

Being acquired can significantly disrupt organizational processes in the acquired company due to the reduction in its organizational autonomy (Haspeslagh and Jemison, 1991). The larger organization, on the other hand, are not necessarily disturbed and can use the new acquisition to grow (idid). Hence, Synopsys can renew themselves. Some studies have concluded that the balance lies in ambidexterity (Benner and Tushman, 2003), whereas others have concluded that the answer lies in a punctuated equilibrium (Burgelman, 2002). Ambidexterity refers to the synchronous pursuit of both exploration and exploitation, and punctuated equilibrium refers to temporal rather than organizational differentiation via cycling through periods of exploration and exploitation (Benner and Tushman, 2003; Burgelman, 2002).

For Synopsys this balance is especially important to maintain, but easier to execute, since acquisitions can be done quicker and hence quicker balanced.

Therefore it is not necessary to establish an organization that can do both (either simultaneously or in sequence), because this balances can be kept in acquisitions.

### 6.5.6 Summarizing technological fit

This section analyzed how ecosystems and technological roadmaps enhance competence-based acquisitions. It is confirmed that Synopsys are able to acquire smaller companies with a successful *Technological fit*, because the industry is created around technological roadmaps. In accordance with literature, the technological roadmaps create acquisition alignment with industry needs. The ecosystem metaphor was used to analyze how these technological roadmaps are sustained and developed, aligned with existing research. And showed that Synopsys can be seen as a niche player in the overall IC ecosystem. The ecological ecosystem was found to grow around the roadmaps, and different companies to specialize in specific parts of the development. Moreover, consistent with existing research, Roadmapping can provide a mechanism to help experts forecast technology developments in targeted areas. The effects of technological roadmaps for Synopsys on both a corporate and industry level were analyzed.

On an industry level, technological roadmaps enables industry player such as Synopsys to identify companies with complementary technologies and knowledge and thereby making better technological investments in line with existing findings. Secondly, industry technological roadmaps were found to enable Synopsys ecosystem strategy, which to a certain degree is aligned with existing research. *Thirdly,* based on the analysis, industry technological roadmaps and ecosystem were found to enhance acquisitions. *Finally*, based on the analysis industry technological roadmaps is found to enable acquisitions with great technological precision. The last two points are not cover in existing literature.

On the corporate level, First, corporate technological roadmaps were found to enhance acquisition-planning integration. Secondly, corporate technological roadmaps link industry technological roadmaps and acquired assets. Finally, corporate technological roadmaps enhance integration of *Human Capital*. All three are avenues not covered in existing research. Based on the analysis in section 5.3 it is argued that Synopsys has been able to utilize both exploitation and exploration through its many domain-extending acquisitions. Acquisitions may challenge the innovative edge of the acquired organization, but balancing a mix exploration and exploitation enables successful performance consistent with our literature review. Moreover, partly consistent with literature Synopsys was found to increase novelty and quality of innovations through acquisitions. Based on the analysis, and coherent with existing research, acquisitions might give short-term innovation, but may not provide future innovation competences. Balance between exploration and exploitation is found to easier to execute due to the speed of the integration process, an avenue not covered in existing literature.

## 6.6 The integration process

Theoretically, there are several advantages of a speedy post-acquisition process. First of all, from a financial perspective, time is an obvious resource not to be wasted. This "time is money" notion in acquisition is logic and well academically proven (Angwin, 2004; Ashkenas, R.N and Francis, S.C, 2000; Epstein, 2004; Habeck, Kröger, F, and Träm, M.R, 2000). This analysis will not concentrate on if time is money, but rather why time is money, in a process perspective. This comes to show that planning should commence as early as possible, and that the actual integration can, and should, be speeded up, in most instances. To guide the analysis on The Integration Process, the following sub question is posed: *How does the integration-speed and-process influence competence-based acquisitions?*

### 6.6.1 Plan - The sooner, the better!

Synopsys integration practice can be divided into two parts; a managerial planning process and the actual implementation ( INTV 3, 2013). The managerial process of every acquisition should be undertaken at the first possible time (Angwin, 2004). In Synopsys, this is usually six weeks beforehand, depending on the acquisition ( INTV 3, 2013). As a clear part of the integration process a standard set of milestones are applied in the major of their acquisitions, depicted in table 7.

On a managerial level Synopsys has a well-structured approach to post acquisition integration (INTV 6, 2013).

*"Synopsys outperform the industry in the efficiency and success of acquisition integration."*
*- INTV 6 (2013)*

In some cases the operationalization of Synopsys' approach is not always successful. With the integration of Company 3, Synopsys increased their service offered to also include synthesis and verification through the combination of the synthesis tools being developed in both companies into one strong product; Crouching tiger (INTV 6, 2013). The vision for the integration was to become a market leader in the EDA industry (ibid.). The development of the crouching tiger software created internal power struggle between the former Company 3 R&D engineers and their counter parts in Synopsys (INTV 6, 2013). A classical conflict arising from *operational resource sharing* caused the challenges and tensions arising when combining the R&D

| Milestone | Projected integration duration |
|---|---|
| ***Migration of website*** | Day of closing |
| ***Moving acquired employees to Synopsys computer systems*** | 1 week |
| ***The reporting structure and where it fit in the organization*** | Day of closing |
| ***Defining which employees to keep*** | 4-6 weeks |
| ***Product road maps*** | 90 days |

*Table 7 Synopsys Integration milestones ( INTV 3, 2013; INTV 6, 2013)*

resources and having to jointly coordinate their use (Haspeslagh and Jemison, 1991). Thus, partially consistent with existing literature strong organizational linkages may disrupt the development process and decrease the time to market (Haspeslagh and Jemison, 1991; Puranam, Singh, and Zollo, 2003). The lack of action resulted in the erosion of more that 50% of the acquired company's market share (INTV 6, 2013).

*"If you look from October (2001.) and two years forward we had lost more than 50 % of the business."*
*- INTV 6 (2013)*

Due to internal conflicts Synopsys is not able to fulfill their promises to the customers, and the software-solution was more than half a year delayed (INTV 6, 2013). Thus, resulting in diminishing long-term customer loyalty, and stressing the importance of a fast integration. The Company 3 integration problems are an example of *value destruction*; where the employees expected to increase economic value end up destroying it (Haspeslagh and Jemison, 1991). Synopsys had an overall vision for where the organization was heading, but the operationalization of this managerial plan was not made clear to the R&D team (INTV 6, 2013). Thus, a critical element in successful integration was lacking; communicating a clear plan of the integration process to employees and customers are important for successful integration (Kotter, 1995; Haspeslagh and Jemison, 1991; Hitt, Harrison, and Ireland, 2001).

*"We had complementary R&D capabilities and through it's on how to run the business within our respective market segments" - INTV 6 (2013)*

However, as the scientific and technical knowledge of Company 3 was highly complementary to that of Synopsys, the transfer of knowledge is important, as it is a key driver for novel innovations and thus the increasing future Innovation Performance (Makri, Hitt, and Lane, 2010; INTV 6, 2013).

### 6.6.2 Speed in the integration implementation

The previous section covered the important of effective planning of the integration process. This analysis focuses on how integration speed affects acquisitions.

In an industry characterized by rapid technological change, the market is driven by time-based competition (Hitt et al., 2001; Kleer and Wagner, 2012), where companies attempt to increase future profits by rapidly introducing new innovative products, taking on substantial market risk and costs (Hitt, Harrison, and Ireland, 2001). Thus, fast integration should be a key element in ensuring future profit for Synopsys. Support is found for this notion in all interviews. The management teams interviewed were clearly very focused on fast integration, on a top-management-level ( INTV 2, 2013; INTV 3, 2013). Exemplified by the acquisition Sandwork Design Inc. where Sandwork's products were sold with Synopsys tools on the day of the acquisition announcement (Synopsys , 2007). Thus, the products were highly complementary and were easy to integrate into the existing portfolio. The idea, at management level, is that the faster the post-acquisition integration is completed, the faster returns on investment are realized ( INTV 3, 2013). This has resulted in a rule of thumb in Synopsys, that post-merger integration should be completed before 100 days have passed ( INTV 1, 2013; INTV 3, 2013).

*"We need to find out with solution to continue to support and how to move customers to this solution. (...) and which capabilities to move from the non-supported tool to the supported. "*
*-INTV 3 (2013)*

Synopsys integration history reveals that a speedy integration can also have social and psychological benefits. Synopsys engineers did not seem to like job insecurity ( INTV 1, 2013; INTV 6, 2013) Fast acquisition integration can reduce the time employees experience uncertainty and at the same time improve the stakeholder enthusiasm, consistent with Haspeslagh and Jemison ( 1991).

The Magma integration happened quickly, through road shows and frequent interaction, and involvement of the customers. New technological roadmaps were designed covering which tools to continue to support and which important complementary functionality to move to these tools ( INTV 3, 2013).

Hitt et al., (2001) are in line with results from Synopsys, as early actions on the anxiety among employees decrease their fear and therefore cause long-term coordination benefits. Thus, consistent with existing research, speed of integration causes long-term coordination benefits in areas such as employee retention, stakeholder enthusiasm and customer loyalty (Haspeslagh and Jemison, 1991; Hitt et al, 2001; Puranam et al., 2003).

*"Within the first 90 days people need to feel that they integrated into the company, else they will not stay an become a part of the company (Synopsys)"*
*- INTV 4 (2013)*

Externally, a rapid integration may also serve to reduce exposure to the uncertainties of the environment, and it is also attractive in terms of competitive strategy (INTV 4, 2012). This was the case with the Magma acquisition, when a fast integration was important to retain customers and integrate the acquired engineering talent ( INTV 3, 2013). The speed of integration reduces the time available for competitors to respond to the new organization. This can give substantial immediate positional advantage as well as presenting competitors with a barrier to imitation ( INTV 3, 2013; Angwin, 2004). Thus, fast integration reduces the time available for competitors to respond.

Customers may likewise fear instability and seek competitors' products if the visible aspects of the integration are not achieved rapidly, as was the case with the Company 3 acquisition, which resulted in massive loss of market share (INTV 6, 2013; INTV 2, 2013). However, in recent acquisitions within Photonics such as RSoft and VaST Systems Technology Corporation, a speedy integration process would have detrimental effects. As, this market is unknown to Synopsys and the success is therefore contingent by successful preservation to effective transfer the needed market related knowledge (INTV 6, 2013). And the right Structures for the knowledge sharing need to be developed through collective interactions (Felin et al., 2012).

In special cases Synopsys applies a symbiosis approach with long integration time-frame, due to lack of market knowledge and high brand value ( INTV 3, 2013; Haspeslagh and Jemison, 1991). The repositioning of the acquired company's product brand depends heavily on the strength of these brands. One of the recent acquisitions in an adjacent market, Optical Research Associates is still not fully integrated due the brand value in its market space ( INTV 3, 2013).

*"Since it such a different space, and they are successful, the organization can remain intact for quite a while and the integration will be very slow."*
*-INTV 3 (2013)*

Based on the findings in section 6.5.5 *Exploration and exploitation* and 5.3 Synopsys acquisition history it can be argued that in a *symbiosis* approach, an *exploration strategy* should be applied (Haspeslagh and Jemison, 1991). Based on the findings in this section, a relatively long and slow integration process is needed (ibid.). As it is in the integration process new capabilities are created through the interactions of the involved individuals (Felin et al., 2012) . In the case of the acquisitions within the EDA industry of companies with highly complementary assets, such as the Sandwork Design Inc. acquisition, explained earlier in this section, an Absorption strategy is applied (Haspeslagh and Jemison, 1991). In this type of acquisitions Synopsys is interested in the fast exploitation of the acquired resources (INTV 6, 2013). Thus, in line with existing research Synopsys is focusing on the relative importance of an exploitation- or exploration-strategy rather than fast integration speed (Puranam et al. 2006).

### 6.6.3 What is speed?

From the latter, it is evident that speed in integration is mostly positive in known industries, but not how it is measured. In this section it will be shown how it should be relative to the size, difference and objective. 100 days is a amongst practitioners as a benchmark for progress and relates them to top executive perceptions of performance (INTV 3, 2013). In terms of the importance of action in the first 100 days, there is no evidence that provide strong support for the first 100 days, suggesting that this time frame is perhaps more based on convenience rather than substance. (Angwin, 2004) However, there does appear to be an association between the volume of changes made in the first 100 days and perceptions of acquisition success in the third and particularly the fourth year of life (ibid.). As the internal relatedness is relatively high in the EDA industry, fast integration of the acquired assets is preferred (Homburg and Bucerius, 2006; INTV 6, 2013). With related strategic orientation and organizational culture, the majority of the acquisitions Synopsys were absorbed (Homburg and Bucerius, 2006; INTV 6, 2013). This was evident in the ViewLogic and Magma acquisitions. In absorption integrations, an integration calendar with credible milestones, like the Synopsys integration milestones, is important to maintain the fast pace the integration process (Haspeslagh and Jemison, 1991). There are no standards for what fast or slow integrations are, and the context of each acquisition differs (Haspeslagh and Jemison, 1991; INTV 3, 2013). Furthermore, it is not yet clear whether speed will affect preservation approach of integration considering that there is less integration between the companies.

### 6.6.4 Summarizing integration speed

The analysis of the Integration Process has shed light on a number of interesting findings on the influence of integration speed on acquisitions. *First,* internal conflicts caused by the lack of effective communication let the researchers to the conclusion that strong organizational linkages may disrupt the development process and decrease the time to market, partially congruent with existing literature. To avoid such conflicts, effective communication is important. Thus, as suggested by existing research, communicating a clear plan of the integration process to employees and customers are important for successful integration.

Synopsys, is in the planning of the integration, focusing on the relative importance of an *exploitation- or exploration-strategy* rather than *fast integration speed* consistent with the findings of existing literature. Moreover, speed of integration is found to have long-term coordination benefits areas such as employee retention, stakeholder enthusiasm and customer loyalty in line with arguments of existing research. Fast integration was found to pose a strategic advantage as it reduces the time available for competitors to respond as found by current literature. However, focus should be on an *exploration and exploitation* rather than fast integration speed. Partially consistent with theory, correct integration speed varies in Synopsys acqusitions. Congruent with existing literature, Synopsys integration milestones, is important to maintain the fast pace of the integration process in exploitation acquisitions.

# 7 Discussion

This discussion will evaluate the findings of the analysis. This will be done in three separate sections with supporting previous findings, contradictions and new findings. Each of these sections is structured following the six elements of the ETA model; *Human Capital, Learning from Experience, Complementarity, Innovation Performance, Technological Fit, and The Integration Process*. The first section, support for previous findings, will credit previous research findings that seem to be applicable in a high tech environment, and discuss minor discrepancies. The second section will discuss contradictions with previous findings, and evaluate which of these findings that are best generalizable to high tech industries in general. The final section, new findings, will discuss how the findings that are not covered by research can complimenting existing theories, and open up for new ones.

This chapter is finalized with discussion of the altered version of the ETA model, which incorporates changes and additions derived from the previous parts of the discussion.

All of the results appear in tables on top of the actual discussion.

## 7.1 Supporting prior research

This section will discuss how results from this analysis support and nuance previous research. Table 9, above, provides an overview of the collected findings that support and evolve previous research.

In relation to *Human capital*, the analysis indicated that acquisitions in the EDA-industry enables acquirers to redeploy resources to and from the acquired company, and rationalize acquired resources, leading to increased innovational performance and efficiency (Capron, 1999). In Synopsys this occurred though operational resources sharing, by rationalizing administrative resources and placing the integration focus on retaining R&D talents (Haspeslagh and Jemison, 1990; Ranft and Lord, 2000; Coff, 2002). Contrasting to the following layoff, all Synopsys acquisitions have been friendly, and even though some of the competences are redundant, this has helped the all-important retention of the desired acquired competences in R&D (Muehlfeld et al., 2012; Ranft and Lord, 2000; Coff, 2002). The results are consistent with prior findings, and can be generalized to other similar industries. Hence, through friendly acquisitions, rationalization and resource redeployment, high tech companies can increase efficiency and innovational performance (Haspeslagh and Jemison, 1990; Ranft and Lord, 2000; Coff, 2002). As illustrated by previous research, a competence-acquirer encounters a high risk of paying a premium for unique R&D competences. However, Synopsys countered this risk by having extensive acquisition experience (Coff, 2002), and, when combining the collected results of this thesis, it is assumable that other serial acquirers will be able to do this as well. When acquiring unique products Synopsys were found to retain sales and marketing specialists due to their specialized sales competences imbedded in their specific tacit knowledge (Ranft and Lord, 2000). However, the findings of Ranft and Lord (2000) did not cover specific types of key employees; therefore their conclusion can only be partially verified. Contrasting, their quantitative study focus on M&A in high tech industries related to the EDA industry.

| Findings – Supporting prior research | Authors |
|---|---|
| **Human Capital** | |
| Acquisitions enable acquirers to redeploy and rationalize human resources contributing to increased performance. | Capron, 1999 |
| Retaining human capital is especially vital for knowledge-intensive acquisitions | Ranft and Lord, 2000; Coff, 2002 |
| Knowledge-intensive industries risks paying a premium for talent | Coff, 2002 |
| Acquisitions experience mitigates the risks of paying a premium | Coff, 2002 |
| Competence-motivated acquisitions should be kept friendly | Muehlfeld et al., 2012 |
| Learning from experience | |
| Experience can be gained from unsuccessful acquisitions | Muehlfeld et al., 2012 |
| Synopsys are successfully utilizing their experience in large acquisitions to ensure successful integration and increase performance | Ellis et al., 2011 |
| Managers underestimate the vastness of the integration task, even in closely related acquisitions resulting in poorer innovation performance | Ahuja and Katila, 2001 |
| **Complementarity** | |
| Complementary knowledge increases innovation quality | Makri et al., 2004; Flemming, 200 Cassiman et al., 2005 |
| High-technological relatedness and incremental change, will erode the post-acquisition performance | Makri et al., 2004 |
| Relaying only on internal R&D decreases speed, and innovation levels and increases risk | Wagner and Kleer, 2007 |
| Increase R&D performance by acquiring the best talents with complementary science and technology knowledge | Makri et al., 2004 |
| **Innovation Performance** | |
| Technological acquisitions can enhance innovation performance | Haspeslagh and Jemison, 1991 Ahuja and Katila, 2001 |
| Synopsys use an absorption strategy when acquired firms have complementary product portfolio | Haspeslagh and Jemison, 1991 |
| Synopsys use a preservation strategy when acquired firms processes unique products | Haspeslagh and Jemison, 1991 |
| Innovative competences can be acquired | Bresman, et al., 1999; Larsson, et 1998; Haspeslagh and Jemison, 19 Hitt et al., 2001 |
| High tech firms should acquire targets with complementary technical and scientific knowledge | Makri et al., 2004 |
| Synopsys need to have a continuous emphasis on maintaining and enhanceing innovation as a part of a focused acquisition strategy in order to stay competitive | Hitt et al., 2001 |
| Due diligence evaluation is based on financial measure, technological and scientific knowledge stocks | Makri et al., 2004 |
| Innovation performance is positively affected by complementary technological and scientific knowledge | Makri et al., 2004 |
| The acquisitions of proven innovation reduces risk and decrease the time to market for the acquiring firm | Hitt et al., 2001 |

| Findings – Supporting prior research | Authors |
|---|---|
| **Technological fit** | |
| Acquisition alignment with industry needs | Meyer and Kenny, 2004; Katila and Ahuja, 2002; Garcia and Bray, 1997 |
| The ecological ecosystem grows around the roadmaps, and different firms to specialize in specific parts of the development | Iansiti and Levien, 2004 |
| Technological roadmaps enables industry player such as Synopsys to identify companies with complementary technologies and knowledge and thereby making better technological investments | Rinne, 2004<br>Miller and O'Leary, 2007 |
| IC-industry can be seen as an ecosystem | Iansiti and Levien, 2004 |
| Roadmapping can provide a mechanism to help experts forecast technology developments in targeted areas | Garcia and Bray, 1997 MacMillen et al., 2000 |
| Balancing a mix exploration and exploitation enables successful performance | March, 1991<br>Haspeslagh and Jemison, 1991 |
| **Integration Process** | |
| Communicating a clear plan of the integration process to employees and customers are important for successful integration | Kotter, 1995<br>Haspeslagh and Jemison, 1991<br>Hitt et al., 2001 |
| Synopsys is focusing on the relative importance of an exploitation- or exploration-strategy rather than fast integration speed | Puranam et al., 2006 |
| Speed of integration has long-term coordination benefits | Haspeslagh and Jemison, 1991; Hitt et al, 2001; Puranam et al., 2003 |
| Reduces the time available for competitors to respond | Angwin, 2004 |
| Synopsys integration milestones is important to maintain the fast pace integration process | Haspeslagh and Jemison, 1991 |

*Table 8 Findings of the analysis - supporting prior research*

| Findings – Partly supporting existing research | Authors |
|---|---|
| **Human Capital** | |
| Unique products demands retention of sales and marketing specialists due to their product specific tacit knowledge | Ranft and Lord, 2000 |
| Acquired leaders, fitting into the Synopsys culture, foster change and enabled the realization of planned, and sometimes unknown, synergies | Graebner, 2004 |
| **Learning from experience** | |
| Acquisition process codification can increase future performance | Zollo and Singh, 2004<br>Coff, 2002<br>Muehlfeld et al., 2012 |
| An internal and specialized planning team can enhance the acquisition performance | Haspeslagh and Jemison, 1991<br>Kim and Finkelstein, 2009 |
| **Complementarity** | |
| Integration is important to leverage the real value of the acquired competences to develop next generation software. | Ranft and Lord, 2000; Makri et al., 2004 |
| **Innovation Performance** | |
| Internal R&D can create the "right context" for acquired technologies | Cassiman and Veugelers, 2006 |
| Acquired companies should have high internal, and low external relatedness | Homburg and Bucerius, 2006 |
| **Technological fit** | |
| Synopsys can be seen as a niche player | Iansiti and Levien, 2004 |
| Industry technological roadmaps enable Synopsys ecosystem strategy | Iansiti and Levien, 2004<br>Meyer and Kenny, 2004 |
| Acquisitions might give short term innovation, but may not provide future innovational capabilities | Puranam and Srikanth, 2007 |
| **Integration process** | |
| Strong organizational linkages may disrupt the development process and decrease the time to market | Haspeslagh and Jemison, 1991<br>Puranam et al., 2003 |
| Correct integration speed varies | Haspeslagh and Jemison, 1991<br>Angwin, 2004 |

*Table 9 Findings of the analysis - partly supporting prior research*

Hence, their findings may be overall correct, but not as detailed at the results from this analysis. Overall, this thesis extend the results of Ranft and Lord (2000) by showing that specific knowledge areas outside R&D can be an asset to high tech acquirers.

The analysis indicated that acquired leaders can foster change and enable both planned and unknown synergies in the integration of acquired competences (Graebner, 2004), but in Synopsys this was only the case with leaders capable of adapting to the Synopsys culture. Graebner (2004) argues that the retention of acquired leaders is vital to avoid integration problems, but Synopsys does not place specific emphasis on this area. On the other hand, Synopsys have a long history of successful managers, which have joined the company through acquisitions. This indicated that the findings of Graebner (2004) are generalizable, as the research is based on a similar research approach and cases, but based on high tech computer science companies (Graebner, 2004). Hence, over a broader industry overview, acquired leaders can be a resource of renewal and diversity, and high tech acquirers, including Synopsys, can use these findings to enhance acquisitions performance and yield.

Based on the findings from *Learning from experiences,* it seems that Synopsys are able to learn from their mistakes, even with unsuccessful acquisitions (Muehlfeld et al., 2012). Even more important, Synopsys is found to harness their experience in large acquisitions to ensure a successful integration process and increase performance from future competence based acquisitions (Ellis et al., 2011).Hence, implying that high tech companies can increase performance and integration success by utilizing their prior experiences. On the other hand, Synopsys managers underestimate the extensiveness of the integration task, as it is distributed to several different business units and the process is not given sufficient attention (Ahuja and Katila, 2001). This result in low Innovation performance, even in closely related acquisitions (Ahuja and Katila, 2001). On the other hand, Synopsys can utilize the capabilities of their internal acquisition unit better, by having one unit dedicated to the task of managing post-acquisition integration, which is found to have a positive influence on acquisition performance (Haspeslagh and Jemison, 1991; Kim and Finkelstein, 2009). The study by Kim and Finkelstein is based on the US commercial banking industry and the findings may be generalized to the American EDA industry, as the M&A legal requirements and corporate structure are much alike since both industries are US based. The findings of both Haspeslagh and Jemison (1991) and Kim and Finkelstein may be applied to high tech industies.Hence, it is safe to assume that serial high tech competence acquirers can benefit from an internal acquisitions process unit to handle the entire acquisitions process.

The analysis found the codification of acquisition processes at Synopsys to increase future performance, which is supported by the findings of Zollo and Singh (2004) and Coff (2002). Thus, to gain value from acquisition experience, high tech companies need to codify their knowledge. Although Muehlfeld et al. (2012) reach the same conclusion, their findings only hold true for or structurally similar acquisitions. As the majority of Synopsys acquisitions were domestic, the findings are to a large extent in line with Muehlfeld et al. (2012). On the other hand, one of the limitations of generalizing these findings is that their study only focuses on the completion of an announced deal rather than integration performance. These results cover the entire integration process, and results are consistent in 46 acquisitions over nearly 20 years. Hence, this these extent and cover the limitations of Muehlfeld et al. (2012) study. It can be argued that it can be argued that acquisition process codifications can increase future performance even in structures of the acquisitions differs.

In competence-based acquisitions, *Complementarity* of the acquired competences is important in order to realize value from the high tech acquisitions (Makri et al., 2004; Flemming 2001; Cassiman et al., 2005). On the other hand, similarity in the techno-logical competences was found to create incremental change, which some industries may prefer. Moreover, partly consistent with the finding of Cassiman et al., (2005) and Makri et al., (2010), acquisition performance is found to increase through similarity in technical knowledge, as the knowledge need to be close enough to facilitate learning, but not too related to erode post-acquisition perfor¬mance. Hence, it can be deducted, that acquired technical knowledge should be similar in background, but uses of this knowledge (competences) should be complementary, in order to be effective in high tech acquisitions.

This analysis found the Synopsys acquisitions increase R&D performance through acquiring the best commentary scientific and technolog¬ical competences (Makri et al., 2004; Kleer & Wagner, 2007). Moreover this thesis supported previous findings, by showing that that focusing on internal (not complementary) R&D, decreases innovation speed, as well as increase risk (Kleer & Wagner, 2007). The success¬fully post-acquisition integration of the acquired complementary competences was found to be where most value is created, as Synopsys leverage these competences by developing the next generation software (Ranft and Lord 2000, Makri et al., 2004). This paper is extending prior research, as the findings indicate the connection between successful integration of complementary competences and the development of next generation software. Thus, implying the integration of acquired competences is important in for the development of future innovations. This is only partially consistent with Ranft and Lord (2000), and Makri et al., (2004) as their research is not directly related to the development of next generation software, but not contradictory, since the difference can be explained by a differentiation in data. Hereby, this thesis argues that acquisitions of complementary resources can enhance future innovation performance by securing unique competences.

As a part of the analysis on *Innovation performance* this thesis confirmed that high tech innova¬tion competences can be acquired (Bresman, et al., 1999; Haspeslagh and Jemison, 1991; Hitt et al., 2001; Larsson, et al., 1998; Puranam and Srikanth, 2007). By acquiring proven concepts, along with the minds behind, Synopsys reduces risk and decrease the time to market (Hitt et al., 2001). When integrating these acquisitions, Synopsys was found to apply two different approaches in the integration process depending on the type of acqui¬sition. In domain extension acquisitions of target with complementary product portfolio, Synopsys exerts an absorption strategy exploiting the existing competences in the target (Haspeslagh and Jemison, 1991, Puranam and Srikanth, 2007). In domain exploration, targets with unique product portfolio are acquired by Synopsys and integrated slowly using a preservation strategy, to be able to explore new possibilities for innovation in markets adjacent to the EDA industry (Haspeslagh and Jemison, 1991, Puranam and Srikanth, 2007). The findings of this thesis are only partially consistent with Puranam and Srikanth (2007), as they imply that acquisitions may provide short-term innovation, but may not yield future innovation competences. The empirical findings are indicating that even through routines may change, Synopsys is able to utilize the competences of the acquired companies to create future innovations. This difference seem to be cause by the fact the Puranam and Srikanth (2007) do not only look at competence-based acquisitions, and therefore the findings of this thesis should not be generalized outside of this focus on this subject. Therefore, an innovation strategy relying on serial domain- extension or exploration acquisitions is validated by this research, and hereby it is also confirmed that a high tech serial acquirer can have a continuous emphasis on maintaining and enhancing innovation through acquisitions of competences.

The analysis also found the high internal relatedness between Synopsys and the acquired companies make integration less resource demanding (Homburg and Bucerius 2006). Yet, high external relatedness in terms of similarity to the target market and market positions is also found contradicting the conclu¬sions of Homburg and Bucerius (2006). The appli¬cation of the findings of Homburg and Bucerius (2006) to Synopsys is limited by the fact that their data set is based solely on horizontal acquisitions, whereas the majority of Synopsys acquisitions are based on a vertical level. Moreover, the conclu¬sion of this thesis is supported by Capron et al., (2001) as they find high external relatedness in target markets to foster synergies. It is therefore arguable that high external relatedness increase post acquisition performance though the potential realizations of synergies. Synopsys strategic mix of internal R&D and acquired technologies was found to create the right context for successful innovation. In Synopsys the internal R&D covers their core business, logic synthesis, and innovation in related business areas take places though acqui¬sitions, this way of combine external and internal sources of innovation is not covered by Cassiman and Veugelers (2006). This combination of internal and external innovation is too specific for Synopsys be generalized to other high tech industries, because of industry specific dynamics. However, other companies may be able to learn from this strategic mix of innovation. As, this perhaps might be a way for other companies to gain new ideas for the further development of their products portfolio.

The analysis of *Technological fit* found technological roadmaps to enable industry players, such as Synopsys, to identify acquisitions targets with complemen¬tary technologies and competences, thereby identi¬fying technological gaps and possibilities for better leverage of R&D investments (Rinne, 2004; Miller and O'Leary, 2007; Garcia and Bray 1997). Moreover, empir¬ical findings of this thesis confirmed existing research on the notion that technological roadmaps enables technological acquisitions aligned to with industry needs, and that technological roadmaps guide industry experts to forecast techno¬logical development in target areas (Garcia & Bray, 1997; MacMillen et al., 2000; Miller and O'Leary, 2007). This indicates that other high tech industries also will be able to enhance their acqusitional effort with technological roadmaps. The ecological ecosystem of the IC industry was found to enable different companies to specialize in specific parts of the development process (Iansiti and Levien, 2004). Based on their ecosystem driven acquisitions, Synopsys is able to balance a strategic mix of trade-offs between explo¬ration and exploitation resulting in successful perfor¬mance (March, 1991; Haspeslagh and Jemison, 1991). The analysis found Synopsys to possess the competences of a niche player in the IC industry ecosystem, as the ecosystem driven industry technological roadmaps allows Synopsys to know which technologies to acquire and integrate (Iansiti and Levien, 2004; Meyer and Kenny, 2004). These findings show that a strong ecosystem will further enable companies to peruse an acqusitional innovations strategy in high tech industries.

*Integration speed* was found to have long-term coordination benefits for Synopsys, as effective integration ensured customer loyalty and employee retention (Haspeslagh and Jemison, 1991; Hitt et al, 2001; Puranam et al., 2003). Derived from the analysis, internal conflicts arising as a conse-quence of the creating of strong organizational linkages were found to possibly disrupt the devel-opment process, which increase the time to market in some of the acquisitions conducted by Synopsys (Haspeslagh and Jemison, 1991, Puranam et al., 2003). Hence, these findings were only partially consisted with existing research. To ensure an effective integration process, empirical as well as theoretical research, found the communication of a clear plan of action to be vital in high tech acquisition integration (Kotter, 1995; Haspeslagh and Jemison, 1991; Hitt et al., 2001). This study found acquisitions, were an absorption approach was applied in the integration process, to focus on a fast integration pace, in which Synopsys integration milestones are important in order to maintain this pace (Haspeslagh and Jemison, 1991). As the fast pace reduces the time competitors to respond through imitation, this can be especially important in fast moving industries (Angwin, 2004). Consis¬tent with the previous discussions of exploration and exploitation in relation to *Innovation performance* and *Technological fit*, emphasis should be on an exploitation approach rather than Speed of integration (Puranam et al., 2006). Hence, empirical and partial theoretical evidence is found for the conclusion that correct integration speed for Synopsys varies according to the appropriate integration approach (Haspeslagh and Jemison, 1991, Angwin 2004).

| Findings – Contradicting prior research | Authors |
|---|---|
| **Human Capital** | |
| Entrepreneurial leaders can disrupt the integration process | Graebner, 2004 |
| Extrinsic financial rewards were used to retain acquired key employees | Ranft and Lord, 2000 |
| The retention of the acquired leaders in a transition period, was not found to increase loyalty | Ranft and Lord, 2000 |
| **Learning from experience** | |
| Experience from small acquisitions can improve the integration process of larger acquisitions | Ellis et al., 2011 |
| Synopsys primarily base their acquisition evaluations on financial measurements | Mayer and Kenny, 2004 |
| Dedicated team(s) should manage all post-acquisition integration(s) | Haspeslagh and Jamison, 1991 |
| **Complementarity** | |
| Acquisition performance is increased through an appropriate level of similarity in technological knowledge | Cassiman, et al., 2005<br>Makri, et al., 2010 |
| Diversity in top management background have a positive effect on all acquisitions | Krishnan et al.,1997 |
| **Innovation Performance** | |
| Standard timelines can be applied with experience in absorption acquisitions | Muehlfeld et al., 2012 |
| Similarity seems to correlate with successful post-merger innovation performance | Hitt et al., 2001 |

*Table 10 Findings of the analysis - Contradicting prior research*

## 7.2 Contradicting prior research

Concerning *Human capital*, this analysis uncovered findings extending prior research. Results from Synopsys indicate that the retention of the accompanying acquired leaders did not increase the loyalty of the development engineers, even in a transition period (Ranft and Lord, 2000). Hence, a key argument for retaining acquired managers did not seem to have any effect in Synopsys. In addition to this, Synopsys are successful in retaining key employees with extrinsic financial rewards. These findings contradict Ranft and Lords (2000) findings, and the difference seems to stem from different data set. Ranft and Lords (2000) data was analyzed quantitatively over broad spectra of multinational high tech industries, and results align, in many ways, with this research. Thus, this implies that Synopsys successful use of only extrinsic rewards to retain engineers, and the missing effort from manager retention, are specific to the engineers in the EDA-industry. However, a balance between intrinsic and extrinsic rewards to retain target employees in a high tech acquisition is needed, consistent with Ranft and Lord (2000). Their findings are supported by prior research, which has found engineers to be more motived by peer recognition, rather than financial rewards (Higginbotham, 1997). Thus, suggesting that in high tech companies should maintain a balance between extrinsic rewards and intrinsic motivation (Davila, 2003). This research also found that entrepreneurial leaders who are integrated into Synopsys can have a disruptive effect on the integration process, contrary to Graebner's (2004) results. Even though Graebner's data set and methodology is similar to the ones used for this thesis, entrepreneurial leaders was not a concern in the analyzed finance- and communications software-industries. Graebner's analysis also consisted of a much smaller span in size between acquirer and acquisition target, than it is the case with Synopsys. Synopsys is a larger company, and more often integrate startups, with very entrepreneurial leaders who will not fit into a large organization. Being the owner and leader of a small company is a much different situation than being a middle manager of a large corporation. This implies what a large acquirer can gain from integrating acquired leaders, but only if those leaders fit into the organization culture and roles.

This analysis has shown how Synopsys seems to *Learn from experience* in small acquisitions, which can improve the success of larger acquisitions. This contradicts the findings of Ellis et al.'s (2011) quantitative analysis. Even though the acquisition relatedness is high in both data sets, Ellis et al.'s (2011) focused solely on large ($100.000.000+) acquisitions in over 300 companies but only covering 3 years. This short time span, and lack of analysis of long-term effect, makes it hard to generalize Ellis et al.'s (2011) to the present EDA industry, as this industry may be an outlier, and the long-term effect of learning are not included. This thesis covers only Synopsys, but in nearly 20 years of large and small deals, results are consistent. Within the homogenous EDA-industry, results from Synopsys shows that complexity of the integration can be independent of the size of the acquisition, and experience can be transferred all across different acquisitions. Hence, Ellis et al.'s (2011) results seem not to be consistent with Synopsys, and the results of this thesis are likely to cover the competence-based acquisition better, because many of the integration-processes are the same regardless of size. So it is safe to assume that both Synopsys and many other high tech industries can learn from all acquisition, and transfer that knowledge to other acquisitions, with no more than normal regard to size.

The analysis also uncovered another way Synopsys had been able to enhance their acquisitions, and following integrations, over the years. In Synopsys some acquisition experience have be stored in integrated managers. The academic literature does not yet cover the fact that organizations can learn to acquire and integrate, by having integrated managers from acquired organizations. Employees that have been acquired can potentially have knowledge from both side of the acquisition process, and, if they are integrated correctly, that knowledge can be seen at a capacity to better future integrations. In that way, an acquiring company can boost their experience from integrations, and this can have obvious strategic implications.

Interviews with Synopsys employees also revealed that Synopsys primarily base evaluations of acquisition on financial measurements. In contrast, Mayer and Kenny (2004) argued that for Cisco in the IT-infrastructure industry, HR in acquisitions and integration of startups affects integrations results. Therefore, HR and integration of startups should be reflected in evaluations and organizational learning goals. Even though Mayer and Kenny's (2004) research is based on quite similar industries, Cisco has a direct relationship with many of their acquisitions targets prior to the actual acquisition and a large HR effort to integrate newly acquired employees, which enhances the integration process (Mayer and Kenny, 2004). Synopsys do not have the same role in the ecosystem to secure direct influence over the surrounding startups, and do not have any significant HR effort. Hence, Synopsys do not have evaluations including this, or improve capabilities in the areas. The findings of Mayer and Kenny (2004) could therefore provide Synopsys with opportunities if implemented. The focus on retention of development engineers is quite similar in the two companies, but Cisco operates under the assumption that if key managers leave, the acquisition will fail, and therefore HR becomes central. Contrary to this Synopsys, in the EDA-industry, have experienced that top-management retention is not important to successful integration. This may be because the EDA-industry only uses a very specific and similarly trained type of engineers, and this makes the EDA-industry more cultural consistent than the IT-infrastructure industry, so this could explain the lack of focus on HR in the integration process. On the subject of pre-acquisition involvement Synopsys seem to ecologically integrate as a niche player towards larger actors, whereas Cisco could be a larger (keystone) and integrate smaller actors (Cisco also has a revenue over 25 times larger). Synopsys may not be able to realize the same strategic advantages that Cisco have with increased direct (e.g. investment and board membership) ecosystem involvement, due to the sheer size and the more homogeneous EDA-industry. Given the dependence on the ecosystem and human capabilities, this seems to be no argument against implementing Mayer and Kenny (2004) recommendation regarding increased HR in acquisitions and integration in the ecosystem towards startups. Synopsys do not have this integration of HR capabilities, and hence, primarily base their acquisition evaluations on pure financial data, but this may not reflect the total value realized by an acquisition. This may not be as central to Synopsys as to Cisco, but could potentially enhance Synopsys acquisition process further.

Considering the actual management of the integration process this analysis also uncovered academic misalignment with practice in Synopsys. Haspeslagh and Jemison (1991) and Kim and Finkelstein (2009) showed that an internal dedicated post-acquisition integration team could increase the efficiency, but practice in Synopsys is somewhat different. Theoretically, there could be increased efficiency in having a dedicated team to handle the integration process, but neither Haspeslagh and Jemison (1991) or Kim and Finkelstein (2009), based their research or recommendation on high tech industries. Contradictory, most of the integration challenges met by Synopsys consist of technological challenges in integration and communications. It could be argued that the relevant business units within Synopsys would have a stronger background for dealing with precisely these problems. Still there is a lack of an integration effort within the all-important HR segment, and the conclusions have shown how essential Human Capital is for the long-term success of the company. So, even though much of the technical knowledge, that is essential for the integration, is utilized in the integration, Human Capital is not. There seems to be a lack of focus on learning and process excellence, and this could be solved by implemented a specialized implantation team that could work with relevant business units, consistent with learning (Kim and Finkelstein, 2009) and more process enhancement (Haspeslagh and Jemison, 1991; Kim and Finkelstein, 2009).

The empirical findings related to *Complementarity,* contradicts the notion developed by Krishnan et al. (1997). This analysis shows that similarity, rather than diversity, in top management background has a positive effect on all acquisitions. There are several limitations in the data set used by Krishnan et al. (1997), making it hard to generalize their findings to the EDA industry. First, their data set excluded acquired companies, who later became targets. This approach would eliminate the majority of the companies operating in the EDA industry, and especially the domain players in the industry. Secondly, the analysis is based on a wide range of different industries, which may have force the researchers to make general assumptions based on calculated averages for their quantitative study. Finally, the data set only covered a time span of three years, thus the long-term effects of similarity in educational as well as functional background are not included. Hence, Krishnan et al., (1997) results are not applicable to Synopsys. On top of this, the EDA-industry is extremely technological centered and complex, so most leaders need a relevant scientific background in order to understand the industry. All together, there is no reason to believe that the findings of Krishnan et al., (1997) are not applicable outside the EDA-industry, but not inside it either.

One of the avenues not covered in existing research was the fact that acquisitions related to EDA industry with complementary technologies, had to be ignored by Synopsys if there were anything but minor gaps in legal-, business- or sales-models. There have been several examples of Synopsys acquisition that resulted in unrealized synergies and increases administration costs. This erodes possible revenue and scalability of the acquisition, as Synopsys is not able to make proper use of the acquired companies' competences (INTV 6, 2013). This shows that in order for at acquisition to be successful there must be some minimum organizational similarities. This is largely uncovered in the academic literature. On the other hand, the effects of these organisational gaps are with great probability applicable to all high tech acquisitions. Considering Synopsys *Innovation performance*, this study has shown how Synopsys apply standardized time lines in absorption acquisitions. Contrary to this, Muehlfeld et al. (2012) found that a standardization of the integration process would be insufficient due to the uniqueness of every single acquisition. This difference seems to stem from at difference in the analyzed data. Whereas this analysis has focused on high tech acquisitions, Muehlfeld et al., (2012) research was based on the much less technology- and competence-dependent American paper industry. One of the limitations of Muehlfeld et al., (2012) findings is that their study only focuses on the compilation of an announced deal rather than integration performance, and this makes Muehlfeld et al., (2012) less suitable for competence-focused acquisitions. In addition Synopsys integrations are much more technical, and can thus be standardized more precise. This thesis has shown that the companies Synopsys acquire are quite homogenous regarding culture and educational background. This makes all the absorptions integration very monotonous, and suited for standardization. These 2 factors can explain the different results. Thus, it can be deducted that when considering numerous absorption in a specific high tech-industry, and standardized guidelines can with great probability be very effective for absorption acquisitions.Related to the above findings, this analysis also uncovered that the similarity between Synopsys and an acquired company correlates strongly with post-merger innovation effectiveness. This is very logical, and Synopsys acquisitions seem to avoid the usual high transaction costs associated with the integrations process, because acquired technology and competences can be very similar to that of Synopsys. This seems to solve problems related to the transmission of knowledge that would otherwise appear. Sadly, the results from Synopsys cannot be totally generalized, as they assume acquired companies to fall within Synopsys very specific business, legal and sales-terms, and have technology relevant to Synopsys product portfolio. On the other hand, , these results indicate a small, but interesting, point. Much research has recommended that high tech companies should acquire targets with complementary technical and scientific knowledge (E.g. Makri et. al 2001). On the other hand, no research has focused on the possibilities to easily rationalize homogeneous high tech industries by acquisitions. Hence, these results show that acquisition target similarity should be considered in the pre-acquisition evaluations, and properly in the overall innovation strategy with high tech companies. This research also found that Synopsys are able to integrate small start-ups without suffering any significant disruptive effects. This is contrasting to Puranam et al., (2003) analysis on the US IT hardware industry. Although the industries are similar, Puranam et al., (2003) indicated that key employees would leave and products would be delayed after integration. The present findings show that Synopsys acquisition targets do see employees exit, but these employees are outside the area of interest to Synopsys. The all-important development engineers do stay after integration, and products do seem to be on time. This is likely because Puranam et al.'s, (2003) analysis did not include the acquirers' potential ability to vary both the speed and level of the integration. The present results show that Synopsys can integrate a small company without eroding performance of either company significantly. This can properly be attributed to the process oriented integration effort. Hence, the results from Synopsys indicate that not all acquirers will erode the performance of a startup, by integrating it into a large organization.

| Findings – Extending prior research |
|---|
| **Learning from experience** |
| Organizational politics and self-interest may hinder acquisition codification |
| Integrating acquired managers can extend acquisition experience |
| **Complementarity** |
| Related EDA acquisitions with complementary technologies are ignored due to the organizational gaps. |
| **Innovation Performance** |
| Synopsys focus on acquiring only competences and technology |
| **Technological fit** |
| Industry technological roadmaps and ecosystem can enhance acquisitions |
| Industry technological roadmaps enables acquisitions with great technological precision |
| Corporate technological roadmaps enhance acquisition planning integration |
| Corporate technological roadmaps link Industry technological roadmaps and acquired assets |
| Corporate technological roadmaps enhance integration of human capital |

*Table 11 Findings of the analysis - Extending prior research*

## 7.3 New findings

The analysis identified several new research areas, and extensions to existing research. In the analysis of learning from experience, organizational politics and self-interest was found to possibly hinder acquisition codification, which according to Zollo and Singh (2004), has negative effects on company performance. It can therefore be argued that organizational politics and self-interest may create structures constraining the internal routines and capabilities in knowledge codification (Felin et al., 2012; Zollo and Singh, 2004). Hence, this finding extends the existing literature on knowledge codification, as well as Felin et al.'s (2012) theories on capabilities and routines. Moreover, integrating acquired managers was found to extend acquisition experience, allowing active acquirers to extend their program level competences by embedding codified knowledge and organizational learning in acquired managers. Hereby, extending the existing research on organizational learning and knowledge codification in acquisitions (Laamanen and Keil, 2008; Hitt et al., 2001; Zollo and Singh, 2004).

The findings related to *Complementarity* revealed that some EDA acquisitions with complementary technologies are ignored due to organizational gaps. The scalable synergies from the complementary resources do not outweigh the cost of the differences in organizational routines. These findings extend the current research with complementarity and similarities, by adding an additional dimension of organizational gaps. This future research topic is expanded upon in section 9.3.4 on organizational similarity.

Based on the analysis of *Innovation performance,* Synopsys was found to focus on acquiring only competences and technology. Hitt et al. (2001) suggests that this may shift the R&D and innovation focus, creating incentives for "buying" rather than developing competences internally. However, our findings indicate that exactly this combination of internal R&D and the addition of new competences through acquisitions may be a key ingredient in using competence-based acquisitions as an effective innovation strategy. Moreover, Cassiman and Veugelers (2006), support this by claiming that internal R&D can be enhanced by external knowledge-acquisition. Hereby, adding new competences and ideas rather than sticking to existing ones. This may prevent the vicious circle of increasingly incremental innovation (Un, 2010). The managerial implication of this extension of existing theory is covered in section 9.1.

The findings concerning *Technological fit* reviled an interesting extension to the existing theories on technological roadmaps. This research establishes a link between technological roadmaps and acquisitions, extending the findings of Miller and O'Leary (2007), by converging more that capital investments in general, in relation to technological roadmaps. The findings on roadmaps are separated into the effects of industry and corporate level roadmaps. The existing research on industry level roadmaps is extended though two notions. First, that industry level technological Roadmaps and ecosystems enhance acquisitions. Secondly, that they enable companies to perform acquisitions with great technological precision.

The corporate level road maps are found to play an important role as mediating instruments ensuring that the right processes are in place to develop the acquiring company's competences and routines (Felin et al., 2012; Miller and O'Leary, 2007). As, corporate level technological roadmaps were found to: First, enhance acquisition-planning integration, by establishing the structures fostering enhanced routines in acquisition planning (Felin et al., 2012). Secondly, link industry level technological roadmaps and acquired assets, though the creation of internal *Structures* ensuring effective knowledge sharing and coordination (Felin et al., 2012). Finally, by enhancing the integration of *Human Capital*, as internal *structures* enhance the knowledge sharing, coordination and integration of acquired Human Capital (Felin et al., 2012).

The analysis of *Technological Fit*, made another interesting discovery, which found balance between exploration- and exploitation, to be easier to execute due to the speed of the integration process. Extending the findings of Brenner and Tushman (2003), through the discovery of acquisition based ambidexterity, where an organization has the ability to successfully acquire and integrate exploration- and exploitation-acquisitions.

This discussion has shown how this thesis research process has contributed to the scientific body of knowledge on high tech acquisitions. This has included an evaluation of the usefulness of previous research and gives credit to relevant scholars. This discussion have also pointed out some contradictions between previous research and this analysis, and discussed which of them are more relevant to high tech industries in general. Lastly, this discussion also included some new findings uncovered by this thesis. It was shown how these findings relate to and extend related theories on the subject. These findings are used to produce a new version of the ETA model, which reflects how the important aspects of the integration process in works in practice.

## 7.5 The ETA model

The findings of this thesis have led to the following alterations of the theoretically deduced ETA (Effective Technological Acquisition) model. First of all, the model was altered to reflect the interdependencies between the six *Research Topics* in the outer ring. Secondly the *Research levels,* which includes the *Process, Individual and Structure* levels in the inner ring was found to play an important role in insuring support for the development of appropriate routines and capabilities fostering the innovation strategy. In conclusion of the discussion, the resulting alteration of the six *Research Topics* is covered below.

The *human capital* section is renamed to *Optimal human capital* to reflect that only the right kind of human capital should be retained, and all other acquired functions should be rationalized. The second section, *Learning from experience* has been change to *acquisition process competence,* to indicate that experience should be gathered from mutible sources, codified and put to active use in order to benefit future acquisitions. *Complementarity* was revised to *Complementary resources* to reflect the importance of both complementary capabilities and knowledge between the acquired and the existing employees. The research topic of *Innovation performance* was extended to *Innovation performance management* to reflect the importance of active conscious actions to continuous improve and extend the company's innovation performance. Finally, based on these concluding remarks *Integration process* has been changed to *Integration scheme* in the ETA model, in order to reflect the focus on integration level rather than speed.


*Figure 8: The refined version of the ETA model*

# 8 Conclusion

This thesis has shown how high tech companies can use competence-based acquisitions in their innovation strategy. A model based on prior research have been developed, and revised based on results from a case study on Synopsys and the EDA industry. First of all, this thesis has found much prior research to be relevant in high tech industries; giving this and future research a solid foundation in this industry. This research has also led to several new discoveries, namely:

• Effective acquisitions can optimize Human capital in High tech industries

• Codification and integration of experience from all prior acquisitions can enhance the acquisition process and be optimally used in dedicated teams

• Acquisitions benefit from technical complementarity and organizational similarity

• Successful acquisitions can be an effective element of a high tech innovation strategy, if managed and integrated accordingly

• Both healthy ecosystems and all technological roadmaps can guide and enhance high tech acquisitions, and enhance innovation focus and balance.

• High-tech acquirers must prioritize suitable integration process by focusing on the level of integration, which dictates the integration speed

The first section of the analysis focused on the importance and integration of *Human Capital* in high tech companies as a part of the acquisition process. Friendly acquisitions was found to enable acquirers to redeploy and rationalize *Human Capital*. Knowledge-intensive industries risk paying a premium for talent, but acquisitions experience mitigates these risks. After the acquisition, retention of only the needed competences is essential to benefit from acquired *Human Capital*. Both intrinsic and extrinsic rewards should be used to retain target employees. Unique products demand retention of sales and marketing specialists due to their tacit knowledge, but, apart from that, R&D will often be the only valuable high tech competence.

Acquired leaders can potentially foster change and enable the realization of synergies, if they fit to the acquiring organization, but entrepreneurial leaders can disrupt the integration process.

In the *Learning From Experience* section, we analyzed how acquisition experience could be obtained and applied to improve future acquisitions. Our results emphasize the importance of experience, by indicating that leaders in high tech industries underestimate the acquisition process, resulting in poor innovation performance. On the other hand, acquiring organizations can learn from prior acquisitions, regardless of size or success, and even well-integrated acquired managers can be a source of acquisition experience. Acquisition competences can also be enhanced by process codifications, and these should evaluate both financial, processual and competence related measurements. Organizational politics and self-interests may hinder this codification, and this is one of the reasons a dedicated team should be tasked with the whole acquisition process, including codification and planning. This team can be aided by various other business units, considering complexity and size.

*Complementarity* was found to have several implications on competence-based acquisitions. Complementary knowledge between acquiring company and it's target increases innovation quality. Furthermore, acquiring the best talents with complementary science and technology knowledge increased R&D performance. The integration of the acquired competences is important to leverage maximal value in developing next generation software. On a different note, acquisition performance is increased through an appropriate level of similarity in technological knowledge - enough to facilitate learning but different enough to provide new opportunities and the incentives to explore them. In cases of organizational gaps related high tech acquisitions with complementary technologies are ignored. Some negative implications related to complementary, were also identified. High technological relatedness and incremental change may erode the post-acquisition performance of the acquiring company. Moreover, relying only on internal R&D decreases integration speed, innovation levels, and increases risk.

Related to *Innovation performance,* this study found that high tech companies can effectively acquire innovative competences. Moreover, the acquisitions of proven innovation reduce risk and decrease the time to market for the acquiring company. High tech companies should acquire targets with complementary technical and scientific knowledge as this positively affects innovation performance. Furthermore high tech companies  were found focus on acquiring primarily competences and technology, as technological acquisitions can enhance innovation performance. Moreover, similarity seems to correlate with successful post-merger innovation performance. The due diligence evaluation of potential targets should be based on financial measures, technological and scientific knowledge stocks. Two schemes are applied in the integration process. An absorption scheme when acquired companies have complementary product portfolio. In these cases standard time lines can be applied with experience in absorption acquisitions and a preservation strategy when acquired companies with unique products portfolio are integrated slowly to obtaing the taitcid knowdge in the organisation. High tech companies need to have a continuous emphasis on maintaining and enhancing innovation as a part of a focused acquisition strategy in order to stay competitive. Furthermore, Internal R&D can create the "right context" for acquired technologies.

Regarding *Technological Fit*, high tech acquisitions can potentially align the acquirer with industry needs in a very effective manner, with the help of a healthy ecosystem and technological roadmaps. In high tech industries, the ability to make precise technology investment is paramount. Technological roadmaps are a vital tool in this process, enabling acquirers to identify complementary technology and competences, and make effective R&D investments, in both acquisitions in internal development. Both industry- and corporate-technological roadmaps can enhance high tech acquisitions. Industry technological roadmaps can enhance the acquisitions value, by providing accurate information on both the present and the future. Corporate technological roadmaps enhance acquisition planning and integration, and hereby links industry technological roadmaps with internal and acquired assets. It was also found that an ecological ecosystem can symbiotically complement technological roadmaps, by allowing different companies to effectively diversify and combine, according to the ecosystems needs. Research on the *Technological Fit* also revealed that acquirers can balance exploration and exploitation easier due to the speed and ease of the acquisition process, but that acquired competences might only give short term innovation advantages instead of future innovational capabilities.

In terms of *Integration Speed*, high tech companies should focus on the relative importance of exploitation- or exploration-scheme rather than fast integration. Thus, the correct integration speed varies, based on the chosen integrate process. An exploitation scheme reduces the time available for competitors to respond. In an exploitation scheme, integration milestones are important in order to maintain a fast pace of the integration process. In both integration schemes communicating a clear plan of the integration process to employees and customers are important for successful integration. Moreover, a fast integration speed has long-term coordination benefits. Lastly, strong organizational linkages may disrupt the development process and decrease the time to market. Therefore, it is essential to ensure the right balance between organizational integration and disruptions to the acquired company, as it affects the success the entire acquisition.

## 8.2 Limitations of this study

This research was based on a relative small sample of interviewees. The interviewees were both knowledgeably and scientific, and the interviews were thorough. On the other hand, the interviewees may not have information relevant for consideration of another companies or industries, so generalizations should be made accordingly.

The research team would have liked to have made more interviews in Synopsys top management team to validate the findings compared to their views. It should be noted that findings were very consistent in all interviews. On the other hand, the information revealed by interview is an expression of Synopsys present conduct, but may not reflect strategies in the future, due to the fast changing nature of this industry.

Some of the data the research team wished for in the planning phase were unavailable, due to Synopsys information restrictions. Even with personal recommendations, this industry is very secluded.

The research team would like to have included statistical analysis of acquisition prices, value added and number of employees.

The research team would also like to have included an analysis on Synopsys employee reward system. Information on this is restricted, even internally in the organization. Knowledge of this system would have allowed this thesis to contribute with recommendation on how to include more intrinsic rewards, and analyze effect on the present extrinsic rewards and it effects on innvation performance.

The lack of previous research on the, relatively young, EDA industry also proved to be a limitation. This was overcome by making a more generalized analysis on a relatively board literature review in an exploratory rather than an explanatory research design. Hence, it should be noted that this study should serve the following literature as an exploration on a new and important research field.

# 9 Future perspectives

This chapter covers the future implications of the findings of this thesis. First, Managerial implications will illuminate some effects of the ETA model in terms of its use and practical application for managers in high tech companies. Second, Theoretical implications will cover applications on existing theories. Finally, Suggestions for further research will point to concrete subjects that need academic attention, and relate this to appropriate scholars when relevant.

## 9.1 Managerial implications

The findings covered in the ETA model have led to several implications that can benefit acquiring managers in high tech industries. In the following section we present these implications, and guide managers and consultants to actively use the ETA-model.

Acquisitions proved to be an effective way to optimize *Human capital*. Therefore managers need to have a clear strategy regarding which of the acquired competences they need, how long they need them, and how they, as acquirers, can contribute to the acquired organization. This should result in a plan covering time span, placement and motivational options covering all acquired assets. Human capital is hard to valuate, so acquisitions evaluation need to rely on thorough analysis, and preferably experience, to estimate the maximal acquiring price before the acqusitional negotiations. It should also be noted that *Human capital* is hard to retain, if the employees do not want to be integrated into the acquirer's organizations they will have little value.

In relation to *Acquisition Process Competences,* acquiring managers should be aware that codification and integration of all prior acquisition experience is an effective way to enhance future acquisitions. Hence, acquirers should devote resources to post-acquisitions codification, and integrations of acquired managerial experience in the field. In both pre- and post-acqusitional evaluations there should be a broad focus on outcomes related to gained competences, finance, organization, strategy and technology. Most managers and leaders seem to underestimate the acqusitional process, so dedicated teams should handle this in serial acquisitions.

To exploit *Complementary resources* in acquisitions, managers should be mindful of the differences between them and the acquisition target. Complementary technology and associated knowledge should have priority and be well integrated, whereas technological acquisitions with a great similarity will erode innovational efforts. Acquiring managers should value high quality of both the technology, and the human capital behind, in order to gain a strategic advantage in high tech industries. Differences in business model, organization, language, geographic location, legal setup etc. will constitute an additional integration effort, and should be valued accordingly.

I order for a high tech acquisition strategy to be effective, managers must utilize context specific Innovation Performance Management. This will depend on any internal R&D of the acquirer, and the assets of the acquisition target. Overall acquirers should absorb targets for exploitation, and preserve targets from exploration. A more standardized integration process can be utilized for serial absorptions, while preservations will require a more time- and resource-demanding customized process. To achieve the highest innovation performance, targets should have a proven innovation concept, and be similar to the acquirer inside of the organization, but have different customers, products and markets.

For acquiring managers to secure a Technological Fit in acquisitions, the ETA-model offer several implications. Overall technological acquisitions are an effective and fast way to align an acquirer with dynamic industry needs. An industry roadmapping process should be encouraged, as it can provide expert forecasts in targeted areas, and this will enhance several important aspects of an acqusitional innovation strategy. Internal corporate roadmaps can support all of this, and should not be overlooked. An effective industry employing roadmaps is well suited for a more ecological business strategy. Managers should think of their business environment as an ecosystem, and adjust their business strategy to promote the overall health of the ecosystem. Both roadmaps and an ecosystem approach will sharpen industry competition, but overall streamline the industry, giving effective acquirers an edge. Acquiring manager's ability to effectively integrate acquisitions, provides the opportunity to balance exploration and exploitation, and hereby have ambidextrous abilities in a quick and effective manner.

Finally, in order to identify the *Correct integration scheme,* high tech acquirers must prioritize a suitable integration process by focusing on the level of integration (exploitation or exploration), which dictates the integration speed. A low level of integration will be quick and reduces the time available for competitors to respond, whereas a higher level will take longer but provide long-term coordination benefits. Managers should note that integrations will cause disruption, so if the acquisition target is developing under time pressure, higher levels of integration will postpone the development.

By adding these steps to the innovation strategy of high tech firms they can create greater value from acquisitions and increasing the acquirer's financial performance.

## 9.2 Suggestions for further research

This research has led to the discovery of several new topics that need academic attention. A handful of the most obvious suggestions are explained in the following section. When applicable, these discoveries are suggested as possible future research of the scholars used in this thesis.

### 9.3.1 Bureaucracy and organizational politics

Acquisitions will often result in organizational and managerial changes, and this leads to changes in power- and authority structures. The interviews at Synopsys revealed that organizational politics seem to have a great impact on the information academically accessible, and, when analyzed further, on the acquisition process. This is to be expected, since the conditions surrounding an acquisition are ideal for organization politics. Employees can gain, develop, and use power to obtain their individual wishes through political tactics like scapegoating, selective information control, networking or manipulation. The internal power conflicts occurring as a part of the development of the Crouching tiger software (see section 6.6.1) is a good example of the results of organizational politics. It would be interesting to see the extent of this behavior, and how it affects the overall performance of acquisitions. This research team speculates that political behavior in acquisitions can foster so much internal organizational competition that executives, managers and employees fail to attend to external competition and other important market and business issues, and only focus on the internal struggles of the organization. This is briefly touched upon by Haspeslagh and Jemison (1991), and we suggest that scholars' include this line of thought in further research.

Power and politics have rarely been the direct focus of acquisition research, but the literature review in this thesis also included the theory of relative standing (Cannella and Hambrick, 1993). This theory has been used to explain top-management behaviors in different social settings. With the acquisitions included in our analysis, acquired executives are placed in a new social setting with much less power and prestige. The Hardi acquisition exemplified some of these issues (cf. section 6.1.2). It could be interesting to analyze if this loss of standing, can lead to the turnover of executives, and, hence, leadership talent after an acquisition. Hence, we suggest that Cannella, Hambrick or other related authors include this in future research.

### 9.3.2 The cost of an acquisition strategy

This analysis uncovered that Synopsys seem to pay less for its acquisitions, relative to its most prominent competitors. Innovation through acquisitions is a popular strategy in the EDA business, because is reduce risk and speed up the process. But this points to several questions regarding the effectiveness of such a strategy in high tech industries in general. Our findings do to some extent indicate that competitors might have been better at utilizing the acquired competences, as Cadence had acquired fewer companies than Synopsys, but has experienced high growth rate (INTV 6, 2013). In order to make general recommendations for high tech firms a comparison of the innovation strategies for the three largest firms in the EDA industry may provide interesting insights. This research could also investigate if innovating through acquisitions provides additional benefits compared to internal innovation, in the incremental EDA industry. Wagner and Kleer (2007) used the EDA industry as a case study in their paper on innovation through acquisitions, and this research topic could be a worthy extension of their existing research field. Related to this the ETA-model developed in this thesis could be tested with financial data, are contribute to an financial evaluation of an acquisitions strategy.

This paper found that Synopsys have an internal core R&D effort, with acquisitions used to every technology surrounding this core, to be an effective strategy. The relationship between these two approaches needs to be investigated further to find out how they can complement each other in ensuring effective Innovation Performance in different settings. Cassiman and Veugelers (2006) found internal R&D and external knowledge acquisitions to be complementary innovation activities, based on the findings from the Belgian manufacturing industry. This thesis indicates that similar results may be fund in high tech industries, and the application of their study to high tech industries would be a natural extension of the existing research.

The analysis also found that technological roadmaps ease the development process as they define the directions and needs in the industry (Miller & O'Leary, 2007). Since technological roadmaps ease the innovation process, this may decrease the risk of internal innovation compare to acquiring innovation. Hence, implying the need for investigating if technological roadmaps can mitigate the advantages of acquiring innovation compared to developing internal innovation by decreasing the risk premium of internal R&D. Based on their prior research on technological roadmaps in R&D investments, this research topic could be complementing the existing research by Miller, O'Leary or other researchers interested in the financial sides of high tech innovation through acquisitions.

### 9.1.3 How can an industry renew itself?

The analysis of the technological roadmaps in the IC-industry also revealed an interesting dynamic. It would seem that the industry is able to renew itself constantly, and that this relates to the use of roadmaps and a healthy ecosystem, without the usual lifecycle of actors. This contradicts the arguments of Afuah and Utterback's (1997) industry lifecycle framework. According to the industry lifecycle framework strategies, competences and demand for products evolve along 4 stages, and companies need to align strategy to the specific stage in which they are in (Afuah & Utterback, 1997). The IC-industry's incremental innovation and emphasis on product innovation suggest that the EDA industry currently is in the specific stage. One of the distinctive features of the specific stage is the central role of the dominant design, and how it is integrated into the product development. In the EDA industry, there seem to be no consistent dominant design; in fact the most dominant design is renewed consistently in terms on nanometer design (EDAC, 2012; INTV 3, 2013). Hence, the IC industry may have a unique structure consistent with the *specific stage*, as presented by Afuah and Utterback (1997), but this stage seems to be constant, and development in the industry seems to renew technology. Technological roadmaps appear to enhance this effect and the incremental innovation process, as technological roadmaps provide Synopsys with accurate market information for customers and collaborators, now and ahead in time.

We suspect that it is possible to explore the EDA or IC industry process and development using the ideas of Afuah and Utterback's (1997), and link this to an understanding of technological roadmaps in the EDA industry. It could be very relevant to explore if successful ecosystems with technology roadmaps could create a constant stage, and hence, provided a strategy for survival and profit beyond Afuah and Utterback (1997) or similar strategic models.

### 9.3.4 Organizational similarity

The discussion reviled that Synopsys abstained from acquisitions of complementary technologies with gaps to their own legal-, business- or sales-terms. This happens in spite of possible synergies and an application of the of the firms' extensive knowledge codification (INTV 6, 2013). Thus, suggesting that a minimum of organizational similarities is need for competence based acquisitions to be successful.

The implications of organizational similarity on competence based acquisitions in high tech industries need to be investigated in future research. In their study of the effect of strategic and market complementarity on acquisition performance, Finkelstein and Kim (2009) found acquisition performance to be a function of creating synergy from both similarity and complementarity. Thus, by investigating organizational similarity in competence based acquisitions in high tech industries, Finkelstein and Kim are able to expand specific findings in their existing research to new industries. Hence, we suggest that Finkelstein, Kim or other related authors persue this line of thought in future academic endeavors.

### 9.3.5 Roadmaps and ecosystems

This thesis extends the acquisition literature through linking both technological roadmaps and ecosystems to the use of competence-based acquisitions as an innovation strategy. Overall the industry technological roadmaps and ecosystem analogy support each other very well, and both have been descried academically, with results that this research verifies.

First of all, it would be ideal for authors interested in the ecosystem analogy or technology roadmaps to integrate these two research perspectives, and test them in an industry already covered by the other theory. This would be interesting for scholars such as Afuah, Iansiti, Levien, Miller, O'Leary, Rinne or Utterback.

The seemingly very effective coupling of technological roadmaps and ecosystems is largely covered by academic theory, and the connection to acquisition strategy is completely overlooked. It can be deducted from this analysis that industry technological roadmaps and ecosystem can enhance acquisitions overall and even facilitate a greater technological precision within the a high tech industry. Results from Synopsys also indicate that corporate technological roadmaps enhance the integration process, investments and planning phase. This sets a direction of future development of the theories, and shows authors like Iansiti and Levien, that the ecosystem approach and "the keystone advantage" is much related to acquisitions. This subject should be further explored.

This research also uncovered the importance of an articulation of exploitation/eploration strategy in high tech acqusitions, and this was show to be related to roadmaps and ecosystem as well. We extent the work on March (1991) and Benner & Tushman (2003) by showing that acqusitions can be evaluated in these terms, and that acqusitions can be a palusable way of effectively persue a specialized exploitation/eploration or balanced strategy. This filed should be explored further by some of the many scholars working with these theoretical termes, and posible linked to technological roadmaps and/or ecosystems.

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# 10 Technical glossary

All the following technical terms are derived from interviews or http://www.synopsys.com.

**ASIC (Application specific integrated circuit)**: An integrated circuit (IC) customized for a particular use. The maximum complexity in a modern ASIC is over 100 million Logic gates. These ASICs often include microprocessors and memory. Such an ASIC is often termed a SoC. ASICs are designed by use of HDLs. For larger commercial designs, with larger production volumes, ASIC design is more cost effective than FPGA's.

**CAD (Computer-Aided Design):** The electronic design automation of projects that were previously under manual methods, includes; PCB layout, wire design, etc.

**CAE (Computer-Aided Engineering)**: The electronic design automation of projects that were previously under manual methods considered to be electronic engineering functions, such as the design of integrated circuits and computing devices.

**CAM (Computer-Aided Manufacturing):** Electronic design automation applied to the manufacturing process. Involves the planning, scheduling, simulation, and control of advanced manufacturing systems.

Corporate technological roadmaps: This is a technological roadmaps developed internally by a single company/university/laboratory as part of their technology planning. This may be done within the context of a broader industry roadmap or it may be done independently of any external planning.

**EDA (Electronic design automation):** Software tools for designing electronic systems such as printed circuit boards and integrated circuits. The tools work together in a design flow that chip designers use to design and analyze entire IC chips.

**Emulation:** The process by which a device under development and its native software is prototyped before its manufacture.

**Emulators:** A class of EDA products which includes both specialized computing hardware and software. Emulators are used to prototype a design and exercise its native software prior to its manufacture. Many emulators can also be used to perform hardware acceleration of simulation runs.

**Fab:** A shorthand term for "fabrication facility." In this context, refers to an IC manufacturing facility.

**Foundry:** A "for-hire" manufacturing facility for integrated circuits. A foundry manufactures chips for external ("fabless") customers. A captive foundry, on the other hand, manufactures chips for only a single company.

**FPGA Field-Programmable Gate Array:** is an integrated circuit designed to be configured by a customer or a designer after manufacturing. FPGA's are very expensive and only used by industry professionals when fast reconfiguration is central. Hence, FPGA's are often used for prototypes, because the same FPGA to be used in many different applications. For consumer products, mass-produced customized IC is preferable both in size and cost.

**HDL (Hardware Description Language):** One of several specialized high-level languages used by IC designers to describe the features and functionality of chips and systems prior to handoff to the IC layout process. HDL descriptions are used in both the design implementation and verification flows. Currently, the two standard HDLs in use worldwide are Verilog HDL and VHDL. Several proprietary HDLs also exist, mainly for describing logic that is targeted for vendor-specific programmable logic devices.

**IC (Integrated Circuit):** A set of electronic circuits on one small plate (chip) of IC material. Integrated circuits are used in all electronic equipment and have revolutionized electronics. Computers, smartphones, and other digital consumer appliances are made possible by the low cost of producing integrated circuits. ICs can be made very compact, having up to several billion transistors and other electronic components in an area the size of a fingernail.

**Industry technological roadmaps:** This is a technological roadmaps developed collaboratively to address specific needs of multiple companies, either as a consortium or as an entire industry.

**IP (Intellectual Property):** A broad category of written and electronic material that is legally recognized as proprietary to a specific organization. In the electronics field, intellectual property refers to specific portions of a chip or "building blocks" which may be proprietary and/or patented designs of a particular company. These reusable blocks or "cores" may be made available commercially to others as portions of new designs

**Logic gate:** An idealized or physical device implementing a logical operation on one or more logical inputs, and produces a single logical output.

**Logic Synthesis:** Logic synthesis is one aspect of electronic design automation. This is a process where an abstract form of desired circuit behavior is implemented into a design of logic gates. Common examples of this process include synthesis of HDLs. Some tools can generate bit streams for programmable logic devices such as FPGAs, while others target the creation of ASICs.

**PCA (Printed Circuit Assembly):** The manufacturing assembly of printed circuit boards, multichip modules, and hybrids of these two. Includes printing, pasting, component placement, reflow, wave soldering, cabling, and test.

**PCB (Printed Circuit Board):** An electronic interconnect product which is the foundation of most electronic systems. PCBs are used to mount and interconnect chips, capacitors, resistors, and other discrete components required in a piece of electronic equipment. The base material of a PCB is called a dielectric and is generally made of rigid fiberglass, rigid thesis, or flexible thin plastic laminates. Those dielectric substrates are then coated with copper and may be fabricated into single- or double-sided, multilayer, or flexible circuits.

**IC Industry Association (SIA):** The industry association that managed the development of the SIA roadmap development. SIA was created in 1977 when U.S. industry banded together to address competitiveness issues in world markets.

**IC:** A material, which has electrical conductivity between that of a conductor such as copper and an insulator such as glass, and is the foundation of modern electronics. Digital and analog integrated circuits account for about 85% of the current IC production. Increasing research in ICs makes it possible to increases in the complexity and speed. An IC is the most common integrated circuit.

**Silicon:** The most commonly used element in ICs due to its ease of processing and abundance (silicon is the element found in sand).

**Semiconductor:** A material which has electrical conductivity between that of a conductor and an insulator. The most common type (85) of semiconductor is the integrated circuit (IC)

SoC (System on Chip): A single chip on which multiple specialized blocks of logic have been combined. These blocks, which consist of Intellectual Property (IP), may be sourced from a company's internal portfolio, or from commercial providers who are external to the company.

**Technology Roadmap:** A technological roadmaps is the output of the roadmapping process at either the corporate or the industry level. It identified (for a set of product needs) the critical system requirements, the product and process performance targets, and the technology alternatives and milestones for meeting those targets.

**Technology Roadmapping:** Roadmapping is a needs-driven technology planning process to help identify, select, and develop technology alternatives to satisfy a set of product needs. The process results in technological roadmaps

**(Design) Tool:** In the IC-industry, this is shorthand term for an EDA product. Generally consists of a software application, but in some cases may include specialized hardware, as in emulation, hardware acceleration, and rapid prototyping systems.

# Chapter 12 Appendix

## 12.1 Synopsys acqusition history

| Year[1] | Company acquired, detailed information on takeover, acquisition reasons, and price | Price In $ million |
|---|---|---|
| 2012 | **Springsoft:** the combination of SpringSoft's and Synopsys' industry-leading verification technology portfolios will help accelerate delivery of a unified, powerful system-on-chip (SoC) debug environment so customers can continue to meet the demands of today's complex electronic designs. In addition, by integrating the physical design technology and teams from SpringSoft, Ciranova and Magma, Synopsys can accelerate innovation and offer a higher level of automation in custom implementation tools.<br><br>Complements Synopsys' technology portfolio and help accelerate delivery of SoC debug and Custom Implementation Tools to customers.<br><br>"This acquisition will increase Synopsys' investment in Taiwan by growing our local engineering expertise, technology development capabilities and customer support," said Chi-Foon Chan, president and co-CEO at Synopsys. "Combining SpringSoft's team and platform with Synopsys' complementary technology will help Synopsys lead further innovations in debug to more rapidly address the growing verification challenge. Simultaneously, SpringSoft's innovative custom implementation solution and its strong presence in leading Asian, European and U.S. semiconductor companies will help accelerate Synopsys' delivery of automation and innovation to an area of IC design that has been stagnant in the past." | |
| 2012 | **Inventure:** The addition of Inventure's well-respected interface IP and talented engineering team enables Synopsys to collaborate more deeply with the local semiconductor industry and accelerate the development of our interface IP offering including PCI Express and other interface protocols such as USB, MIPI and HDMI. | |
| 2012 | **EVE:** "By adding EVE's technology and engineering talent, Synopsys is expanding its investment in verification to continue to bring new technology innovations to our customers." Manoj Gandhi, senior vice president and general manager of Synopsys' Verification Group. By adding High-Capacity Emulation to their verification platform. | |
| 2012 | **Mask Synthesis Tech.* from Luminescent:** Added Inverse Explorer (IE) and the Inverse Synthesizer (IS) products, their associated IP, and Luminescent's lithography and mask synthesis customer licenses and obligations. Added R&D expertise though the acquired Luminescent employees responsible for R&D and applications engineering supporting the acquired products. | |

1 Follows the calendar year. However Synopsys's fiscal year runs from the 1st of December to the 31st of October the following year.

| Year[1] | Company acquired, detailed information on takeover, acquisition reasons, and price | Price In $ million |
|---|---|---|
| 2012 | **MoSys:** Added 10G SerDes IP technology to their DesignWare Portfolio. The addition of MoSys' IP and their experienced mixed-signal designers will help to accelerate Synopsys' delivery of our high-speed SerDes roadmap, including 10G and PCIe 3.0 PHYs. | 4.3 |
| 2012 | **RSoft Design Group:** Added additional complementary product to the growing adjacent market photonics market initiated with the Optical Research Associates. RSoft's products also complement our TCAD Sentaurus portfolio by providing a number of capabilities that allow us to extend our offering into other photonic areas such as optical waveguide modeling.<br>The combination of Synopsys' imaging and illumination design products with RSoft's photonics design and simulation software extends Synopsys' platform to provide a more complete set of optical solutions to current customers, as well as to support new technologies, applications and markets as they emerge. | |
| 2012 | **Ciranova:** Added technology to accelerate advancements in its custom integrated circuit (IC) design solutions and enable design teams to better meet the productivity challenges created by the complexity of nanometer designs. Reducing the time and effort needed to develop transistor-level layout on advanced nodes.<br>Productivity improvements in custom IC design by reducing the time and effort needed to develop transistor-level layout on advanced nodes. Synopsys is utilizing Ciranova's technology to accelerate advancements in its custom IC design solutions and enable design teams to better meet the productivity challenges created by the complexity of nanometer designs. | |
| 2012 | **Magma® Design Automation Inc.:** Though the acquisition of one its main competitors in the EDA industry. Synopsys gained access to complementary technologies and IP blocks, more rapid development of more advanced design tools and increased they poll of EDA specialists. | 523 |
| 2012 | **ExpertIO:** added Verification IP for industry standard protocols. The addition of ExpertIO's team of protocol experts, along with CEO Craig Stoops, and its strong portfolio of storage VIP will accelerate Synopsys' delivery of a broad line-up of high-performance, easy-to-use, full-featured VIP that can help designers address their growing verification challenges. | |
| 2011 | **Extreme DA:** Added expertise in static timing analysis and multicore software development by adding technology and engineering talent to though the complementary statistical static timing analysis (SSTA) tool suite with and Synopsys PrimeTime® timing analysis. A long with the increase of the mobile device sales | |

| Year[1] | Company acquired, detailed information on takeover, acquisition reasons, and price | Price In $ million |
|---|---|---|
| | support team. | |
| 2011 | **nSys Design Systems:** expanded portfolio of VIP from Synopsys will covering all of the widely used interface protocols and many emerging titles. It will also offer a new protocol compliance test-suite product line. Supported verification methodologies include VMM (verification methodology manual), OVM (open verification methodology) and UVM (universal verification methodology). | |
| 2010 | **Optical Research Associates:** Marked an expansion into markets adjacent to EDA. By Adding ORA's expertise, technology, and products within solid state lighting using light emitting diodes (LEDs), as well as expand into markets such as semiconductor lithography equipment and cameras. | |
| 2010 | **Virage Logics Inc.:** Increased the Designware interface and analog IP portfolio by adding embedded memories with test and repair, non-volatile memories (NVMs), logic libraries, and configurable cores for control and multimedia sub-systems. | 316.5 |
| 2010 | **Coware Inc.:** Added complementary technologies and talent and complements extending Synopsys' activities in the system-level design market segment. | |
| 2010 | **VaST Systems Technology Corporation:** Marked an expansion into markets adjacent to EDA. By expertise, technology and products will allow Synopsys to move into the rapidly growing markets associated with displays and solid state lighting using light emitting diodes (LEDs), as well as expand into markets such as semiconductor lithography equipment and cameras. | |
| 2010 | **Nusym:** Added software for verification closure solutions for electronic products manufacturing companies to its manufacturing solutions. | |
| 2010 | **ZeroSoft, Inc.** added software technology for logic verification of complex, leading edge IC designs to the verifications portfolio from an EDA start-up. | 24 |
| 2010 | **TeraRoute LLC:** Added the T route product to the existing simulation and modeling products. It handles the interconnect of large digital Nano scale layouts while allowing concurrent DFM and SI optimization during auto routing. | |
| 2009 | **Gemini Design Technology:** offered an accelerated SPICE technology that will be use to strengthen our HSPICE technology along with experienced engineering talents such as Dr. Baolin Yang and Dr. Xiaodong Zhang | |
| 2009 | **Analog Business Group of MIPS Technologies:** Expanded the DesignWare® | 22 |

| Year[1] | Company acquired, detailed information on takeover, acquisition reasons, and price | Price In $ million |
|---|---|---|
| | analog IP portfolio by adding a new string of IPs such as Analog-to-Digital Converters, Digital-to-Analog Converters, Audio Codecs and Power Management. As well as it's interface IP portfolio by adding HDMI TX and RX protocols. | |
| 2008 | **CHIPit business unit of ProDesign:** expanded its and its FPDA design in the Synplicity Business Group by adding automated ASIC prototyping solutions providing hardware-assisted verification throughout the SoC and ASIC project life cycles. By adding both technology and knowledge though the integration of the ChipIT team Synopsys strengthen its position on the fast-growing rapid prototyping segment and increasing its ability to address every phase in the verification cycle. | 38,5 |
| 2008 | **Synplicity Inc.:** Provided A new product portfolio of innovative field programmable gate array (FPGA), IC design and verification solutions that served a wide range of communications, military/aerospace, semiconductor, consumer, computer, and other electronic applications markets. As well as essential key knowledge though the integration of the key employees along with Co founder Gary Meyers. | 223.3 |
| 2007 | **ArchPro Design Automation, Inc.** Provided low power verification technologies designed to help customers address power management challenges in multi-voltage designs | 12.9 |
| 2007 | **Assets of MOSAID Technologies Inc.:** Boosted the memory IP portfolio by DR2 memory controllers and related products. | |
| 2007 | **Sandwork Design Inc.:** Added complex analog and mixed signal SoC debugging and analytical tools to the existing Diversity verification platform. | |
| 2006 | **Sigma-C Inc.:** Added optical lithography simulation software and proximity effect correction software to the verification portfolio. | |
| 2006 | **Virtio Corporation Inc.:** Expanded the Synopsys system studio though the addition of virtual platforms for embedded software development. Allowing customers to Speeding up hardware and software development as well as reducing delays and ESL challenges. | |
| 2005 | **HPL Technologies, Inc**.: Added semiconductor IP, data analysis platforms, factory floor systems, and professional services for semiconductor and flat panel display industries. | |
| 2005 | **TriCN Inc.:** Added a string of Interface-Specific I/Os (ISI/O) and SerDes IP core to the DesignWare® interface IP portfolio. Which increase speed and data transmission | |

| Year[1] | Company acquired, detailed information on takeover, acquisition reasons, and price | Price In $ million |
|---|---|---|
| | for a broad range of interfaces and applications. | |
| 2005 | **Nassda Corporation:** Added full-chip circuit verification software for complex nanometer semiconductors to the simulation product portfolio fortifies the analog/mixed-signal offering with complementary products. As well as adding strong engineering talent to the verification team. | |
| 2004 | **Leda Design Inc.:** Expanded the DesignWare® IP portfolio as well as Increasing the DesignWare® IP engineering team with a the 80-person engineering and support team of a developer of mixed- signal IP experienced in digital and mixed-signal IP design located in Yerevan, Armenia. | |
| 2004 | **Integrated Systems Engineering (ISE) AG:** Expansion of the design for manufacturing (DFM) portfolio by technology CAD (TCAD) software products and services. DFM products provided additional befit to existing customers reduce costs and minimize risks prior to IC production. TCAD software aims at transistor (device) structure modeling and simulation of the steps of semiconductor wafer manufacturing processes. | |
| 2004 | **Accelerant Networks:** expanded Synopsys' DesignWare® infrastructure IP portfolio to provide a full offering of standards-based and chip infrastructure IP. Which provide additional customer benefits though low-risk, integrated analog and digital IP solutions by linking Accelerant's unique (serializer-deserializer) cores with its own digital ones. | |
| 2004 | **Cascade Semiconductor Solutions, Inc.:** completed the DesignWare® interface IP portfolio PCI Express string with digital logic IP solutions and PCI ExpressTM digital IP solutions. http://www.semiwiki.com/forum/content/2205-pci-express-ip-vendor-cascade-acquisition-synopsys%85.html | 15,8 |
| 2004 | **ADA Inc.:** extended the analog and mixed-signal offerings of Synopsys. As well as enabling the introduction of novel analog and mixed-signal design technologies though automated circuit optimization solutions for analog, mixed- signal and custom integrated circuits. | |
| 2003 | **InnoLogic Systems, Inc.:** Expanded its professional services with research and verification services to firms using silicon in their products. | |
| 2003 | **Qualis Verification IP:** Added Domain Verification Component (DVCTM) technology into the Synopsys DesignWare® Verification IP. As well as verification methodology consulting and training services by retaining key Qualis staff joined | |

| Year[1] | Company acquired, detailed information on takeover, acquisition reasons, and price | Price In $ million |
|---|---|---|
| | Synopsys, e.g. Janick Bergeron, CTO and expert for verification methodology. | |
| 2003 | **Numerical Technologies, Inc.:** was acquired in order to speed production of sub-wavelength chips as well as reduce costs and manufacturing risk for customers developing power-efficient integrated circuits. Chip-making companies use Numerical's software and other applications to produce integrated circuits with patterns that are smaller than the wavelength of light. Numerical's applications are based on phase-shifting and optical correction technologies that compensate for distortions caused by working in such reduced dimensions. | 250 |
| 2002 | **Co-Design Automation:** Enabled the development of state-of-the-art design language services, especially next generation hardware language verification technology for use in future releases of Synopsys verification products. | |
| 2002 | **inSilicon:** Expansion of the Designware® interface IP portfolio by standards-based connectivity IP for e.g. USB, IEEE 1394, 802.11. | |
| 2002 | **Avant! Inc.:** Completion of Synopsys portfolio of physical design and verification products. As wells as the Avant!'s Saber product, which offers mixed signal system level design tools for power, test, automotive, telecommunications and military/aerospace markets. | |
| 2001 | **C Level Design:** Acqusition of technology assets from nearby C Level Design Inc., and it will integrate the company's CycleC simulation tool into its VCS simulator to accelerate HDL simulations.“The addition of the CycleC technology will benefit customers by making it easier to accelerate their VCS simulations using cycle-accurate C and C++” Manoj Gandhi SJ VP verification group | |
| 2000 | **The silicon Group:** Primarily acquired to gain access to and implement their existing turnkey design services to GDSII. The firm had developed an internal flow to standardize and automate the use of the Avanti tools. | 3 |
| 2000 | **Leda SA** provided Synopsys with complementary tools, e.g rule checkers for VHDL and Verilog. More the acquisition added consultancy and services in customer-specific EDA tool development. | 7,7 |
| 2000 | **VirSim:** "Virsim is a key part of our industry-leading VCS & Sciroccoverification software products," said Manoj Gandhi, vice president andgeneral manager, Verification Technology Group of Synopsys. "The addition of the Virsim technology and development team are strategic to Synopsys'verification business, and this enables us to maximize the value we deliver to customers of our verification | 7 |

| Year[1] | **Company acquired, detailed information on takeover, acquisition reasons, and price** | Price In $ million |
|---|---|---|
| | solutions." Technological acquisions. Purchase of supplier – horizontal acquiotions | |
| 1999 | **Apteq:** which has an expertise in analog simulation and Verilog-A product. Apteq was conducting research and development on extensions to the Verilog language. | 1 |
| 1999 | **Covermeter:** The rights to CoverMeter, a Verilog code coverage tool | 2,3 |
| 1999 | **Smartech OY**: a privately held design services firm with expertise in the design of wireless communication devices. Added 35 employees to the professional services BU in EU | 9,7 |
| 1998 | **System Science:** a developer of tools for electronic design verification and test | 47.1 |
| 1997 | **ViewLogic** provided a wide range of EDA products for both Unix and Windows-based platforms, as well as a full range of support services. | 540 |
| 1997 | **EPIC:** Was acquired to broaden their product offerings and have one company with the best in expertise and best in market position in both high-level design and deep submicron. | 427.1 |
| 1995 | **Arkos:** Added technology that supports very high-speed validation of integrated circuits (ICs) early in the design cycle. | 9,3 |
| 1995 | **Silicon Architects:** Acquisition of the Pioneers of the Structured ASIC(TM) Methodology with patented design technology. Silicon Architects' Structured ASIC Methodology is ideal for complex integrated circuits with multiple memories, data paths and random logic. | 38,5 |
| 1994 | **CADIS** Through this acquisition Synopsys got the communication systems and DSP design tool suit named COSSAP. COSSAP stood for Communication System Simulation and Application Processor. Synopsys carried out various communication (predominantly wireless modems) designs and consulting activities using this tool (and later the evolved new tool Co-centric System Studio). | 4 |
| 1994 | **Arcad:** software developer of VHDL models specializing in telecommunications standards | 1,5 |
| 1994 | **Logic Modeling** added a library of software models for more than 12,0000 commercially available ICs, as well as a line of hardware modeling systems. The goal was to bridge a developing gap between EDA tools and ASIC process technology. simulation models and modeling technologies for the verification of electronic | 118 |

Table 1: acquisitions of Synopsys with detailed information
Sources: Based on information from Synopsys investor relations, SEC 10-K and 10Q forms 1994-2012, EE Times website, investigating.businessweek.com

12.2 Interview guides First version

# Interview guide

**Introduction**

- Name, title.
- Job history.
- Role at Synopsys.
- How did you come to work for Synopsys? Acquired firm?
- Educational history.

**Human Capital**

- Synopsys keeping acquired employees after M&A?
    - How is it done?
    - How many %?
    - How many do Synopsys usually want to keep?
- How about acquired leaders?
    - Are they treated differently than employees?
    - Do they have a different role in the post-acquisition process?
    - Do they represent a special value to Synopsys?
    - Are acquired leaders kept in acquired organization?
    - Are they encouraged to act differently after the acquisition?
- Are new acquired leader different that Synopsys leaders?

**Learning from experience**

- Does Synopsys have a way of codification acquired knowledge?
    - Is it explicit?
    - Does Synopsys have a special way of doing this?
- Does Synopsys poses experience from M&A positively
    - How is that knowledge kept in the organization?
    - Is it utilized in new M&As?
- Is newly acquired organization kept intact, or are they merged into Synopsys?
    - Is there any form of autonomy in acquired firm?

**Complementarity**

- What sort of companies does Synopsys acquire?
    - Strategic value?
    - Complementary technologies?
- Does Synopsys try to acquire R&D through M&A?
    - How is it working? Examples?

**Innovation**

- How is acquired technological used?
    - Are the acquisitions increasing overall innovation performance?
    - Also when considering cost?

- Are complementary technological and scientific knowledge considered in M&A?
    - How is that knowledge used?
    - Does it affect acquisition strategy?
- Can Synopsys acquire innovative skills and competences?
    - Are there any examples of this working?

**Speed of integration**

- How fast are firms integrated?
    - Why?
    - How?
    - Is it always the same?
- Fast integrations cause short-term disruption
    - Is it so at Synopsys?
    - Hwy?
    - How is it overcome?
- Fast integration cause long-term coordination benefits
    - Is that seen at Synopsys?
- Does external and internal relatedness effect integration?
    - How?
    - Why?
- How is success and speed measured?
    - Is it the same way in every acquisition?
- Exploitation in integrations?
    - Is it a balance with exploration of new options and integration speed
- Exploration in integrations
    - Is exploitation of the acquired resources in balance with exploration and integration speed?

**Technology roadmaps**

- How is TR used by Synopsys?
    - Better technology investments?
    - How is it used with external partners
    - How is it used with competition
    - How is it used internally
- Is their a consensus about a set of needs and the technologies required to satisfy those needs in the industry?
    - How does this affect industry innovation?
    - How does this affect Synopsys
- Does Synopsys experts also contribute in to Roadmapping process?
    - How?
    - Is it a gain for Synopsys?

# Interview guide

**Introduction**

- Name, title.
- Job history.
- Role at Synopsys.
- How did you come to work for Synopsys?
    - Acquired firm?
    - Other industry affiliations?
- Educational history.
    - How has it affected your work at Synopsys?
- Can Synopsys buy development skills? How much is bought and how much is done internally?

**Speed of integration**

- How fast are firms integrated?
    - Why?
    - How?
    - Is it always the same?
- Fast integrations cause short-term disruption
    - Is it so at Synopsys?
    - Why?
    - How is it overcome?
- Fast integration cause long-term coordination benefits
    - Is that seen at Synopsys?
- Does external and internal relatedness effect integration?
    - How?
    - Why?
- How is success and speed measured?
    - Is it the same way in every acquisition?
- Exploitation in integrations?
    - Is it a balance with exploration of new options and integration speed
- Exploration in integrations
    - Is exploitation of the acquired resources in balance with exploration and integration speed?
- When is the integration planning begun?
    - When is the implementation begun? How long does it take?
- When looking at fig 1 pp 36. 90?
    - Magma
    - EVE
    - Hardi
    - Viralogic
- Any stories on Chip-it

**Human Capital**

- Does Synopsys try to keep acquired employees after M&A?
  - How is it done?
  - How many %?
  - How many do Synopsys usually want to keep?
- How about acquired leaders?
  - Are they treated differently than employees?
  - Do they have a different role in the post-acquisition process?
  - Do they represent a special value to Synopsys?
  - Are acquired leaders kept in acquired organization?
  - Are they encouraged to act differently after the acquisition?
- Are new acquired leader different that Synopsys leaders?
  - Background?
  - Culture?
  - Work methods?

**Learning from experience**

- Does Synopsys have a way of codification acquired knowledge?
  - Is it explicit?
  - Does Synopsys have a special way of doing this?
- Does Synopsys poses experience from M&A positively
  - How is that knowledge kept in the organization?
  - Is it utilized in new M&As?
- Is newly acquired organization kept intact, or are they merged into Synopsys?
  - Is there any form of autonomy in acquired firm?

**Complementarity**

- What sort of companies does Synopsys acquire?
  - Strategic value?
  - Complementary technologies?
  - How is that evaluated?
- Does Synopsys try to acquire R&D through M&A?
  - How is it working? Examples?
  - Does it complement internal R&D?
  - It is working, and how is it evaluated?

**Innovation performance**

- How is acquired technology used?
  - Are the acquisitions increasing overall innovation performance?
  - Also when considering cost?
- Are complementary technological and scientific knowledge considered in M&A?
  - How is that knowledge used?
  - Does it affect acquisition strategy?
- Can Synopsys acquire innovative skills and competences?
  - Are there any examples of this working?
- Do Synopsys integrate new employees in existing organizations, or keep them in the acquired organizations?

- What kind of innovation does Synopsys acquire?
  - Only Product innovation?

**Technology roadmaps**

- Corporate-level technology roadmaps?
  -
- How is industry technology roadmaps used by Synopsys?
  - Better technology investments?
  - How is it used with external partners?
  - How is it used with competition?
- Is there a consensus about a set of needs and the technologies required to satisfy those needs in the industry?
  - How does this affect industry innovation?
  - How does this affect Synopsys?
- Do Synopsys experts also contribute in to Roadmapping process?
  - How?
  - Is it a gain for Synopsys?

## 12.2 Interview guides

Final version - Acquired employees

# Interview guide

**Introduction**

- Name, title.
- Job history.
- Role at before Synopsys.
    - Role Now
- How did you come to work for Synopsys?
- Educational history.
    - How have I affected your work?
- Could you describe your production here
- Why do you think Synopsys bought this company?

**Speed of integration**

- How would you describe the integration?
    - Do you think it could be done better?
- How fast were this firm integrated?
    - Why?
    - How?
    - Could it be done better?
- Fast integrations cause short-term disruption
    - Was that the case her?
    - How is it overcome?
- Fast integration cause long-term coordination benefits
    - Did you experience that here?
- Does external and internal relatedness effect integration?
    - How?
    - Why?
- How is success and speed measured?
    - Were you happy with the speed of the process?
- Exploitation in integrations?
    - Is it a balance with exploration of new options and integration speed
- Exploration in integrations
    - Is exploitation of the acquired resources in balance with exploration and integration speed?
- Did you have any “bumps” in the integration process?

**Learning from experience**

- Did it seem Synopsys have a way of codification acquired knowledge?
    - Is it explicit?
    - Does Synopsys have a special way of doing this?
- Does Synopsys poses experience from M&A positively
    - How is that knowledge kept in the organization?
    - Is it utilized in new M&As?

- Is newly acquired organization kept intact, or are they merged into Synopsys?
    - Is there any form of autonomy in acquired firm?

**Human Capital**

- How many employees did keep after M&A?
    - How is it done?
    - How many %?
    - How many do Synopsys usually want to keep?
- How about acquired leaders?
    - Are they treated differently than employees?
    - Do they have a different role in the post-acquisition process?
    - Do they represent a special value to Synopsys?
    - Are acquired leaders kept in acquired organization?
    - Are they encouraged to act differently after the acquisition?
- Are new acquired leader different that Synopsys leaders?
- Have management change?
    - How?
    - Why have it change?
    - Is it for the better?
- Have company culture changed?

**Complementarity**

- Why do you think Synopsys acquire you?
    - Strategic value?
    - Complementary technologies?
    - R&D?
    - Production?
- What sort of companies does Synopsys normally acquire?
    - Strategic value?
    - Complementary technologies?

**Innovation**

- How is acquired technology used?
    - Are the acquisitions increasing overall innovation performance?
    - Also when considering cost?
- Are complementary technological and scientific knowledge considered in M&A?
    - How is that knowledge used?
    - Does it affect acquisition strategy?
- Can Synopsys acquire innovative skills and competences?
    - Are there any examples of this working?
- Do you consider the acquisition “hostile”
    - Did you at some point?

**Technology fit**

- How is TR used by this company?
    - Better technology investments?

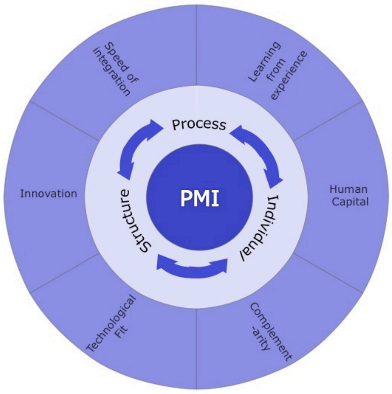
- How is it used with external partners?
- How is it used with competition?
- How is it used internally?
- Did it affect Synopsys acquisition of your company?
- Is their a consensus about a set of needs and the technologies required to satisfy those needs in the industry?
  - How does this affect industry innovation?
  - How does this affect Synopsys
- Do you company and/or Synopsys experts also contribute in to Roadmapping process?
  - How?
  - Is it a gain for you/Synopsys?

- Do you know anyone else we could ask?
- Do have any advice for future acquisitions similar to this?

## 12.2 The different versions of the ETA model

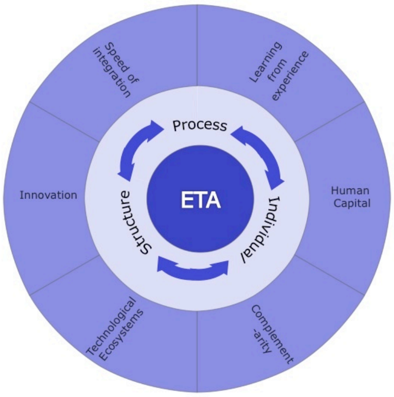
First draft of the model


First final version




Added an additional layer to the model based on 3 layers to consider in the integration. Process, structure, individual

Second version (1. review)




The titles of the elements of the model where changed and reorder to fit the structure of the thesis.

## Chapter 12 Appendix

### 12.3 International Technology Roadmap for Semiconductors

The International Technology Roadmap for Semiconductors (Technological roadmaps) is a fifteen-year assessment of the industry's future technology requirements. The technological roadmaps is produced by industry experts, representative of Semiconductor Industry Associations of the US, Europe, Japan, South Korea and Taiwan.

The technological roadmaps are intended for technology assessment without regard to any commercial considerations.

The roadmap is updated annually and the latest version can always be accessed here:

http://www.itrs.net/reports.html

In this research the 2012 edition have been used:

http://www.itrs.net/Links/2012ITRS/Home2012.htm