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Consolidation In The Electronic Design Automation Industry: An Empirical Analysis Of The Impact Of A High-tech Acquisition On Shareholder Wealth

Abstract

The high-technology industry is characterised by a high volume of acquisitions, most of which are undertaken to tackle an industry-wide pressure to innovate. This study examines the acquisition of Verisity Ltd. by the global computational software company Cadence Design Systems Inc.. The paper uses event study methodology to determine whether this high-tech acquisition was value-creating for the companies involved. Previous literature on shareholder reactions to acquisition announcements commonly finds negative abnormal returns for acquirers and positive abnormal returns for targets. Industry-specific literature also finds acquisitions to be value-decreasing for acquirers in the high-tech industry. However, the results of this empirical analysis do not find significant negative abnormal returns for the acquirer, Cadence, in the short or long run. Further, the examination of abnormal returns in response to a post-acquisition product announcement by Cadence also yields insignificant results. The main implication of these results is that acquisitions are zero net present value projects for acquirers. On the contrary, positive and significant short-run abnormal returns are found for the target, Verisity, supporting previous literature that finds acquisition announcements to be beneficial to target shareholders.

Declaration

This essay is entirely my own and includes nothing that could be interpreted as plagiarism of any other published or unpublished research or of any other student's unpublished work.

1. Introduction

The quality of a firm's output is an important performance indicator in the high-technology or electronic design automation (EDA) industry. Due to this, companies in the industry are constantly seeking out projects that would support them in improving their innovative output. As a by-product of this pressure, EDA and high-tech firms consolidate through mergers and acquisitions in order to achieve innovative and market growth. Cadence Design Systems Inc. alone has conducted 70+ acquisitions since 1988, many taken up in order to expand their market share in the EDA industry.[1] Just as, their 2003 acquisition of Verisity Ltd. provided them with an opportunity to expand their product line in functional verification, a sub-category of solutions within the EDA toolkit.

The literature in mergers and acquisitions (M&As) provides an insightful overview of the expected outcome of Cadence's acquisition of Verisity. A majority of the papers in M&As find acquisitions to be value-destroying for acquirers, with Alexandridis, Mavrovitis, and Travlos (2011) finding evidence that acquirers in the 2003–2007 period were not able to create value through acquisitions. As well as that, researchers have not commonly found a large number of past acquisitions to be indicative of a positive M&A experience for the acquirer. Further, papers looking at post-acquisition innovative performance do not find this to be improved by the acquisition. In fact, Hitt, Ireland, and Harrison (2005, p. 378) cite that Hitt, Hoskisson, and Moesel (1996) find acquisitions to be the cause of a "system that discourages innovation". Nevertheless, previous literature finds strong evidence that acquisitions lead to a positive impact on the target's shareholder wealth.

The main aim of this paper is to examine the impact of this acquisition on Cadence and Verisity's shareholder wealth. In doing so, the paper contributes to previous literature in the field, showing either the deviation of this case from large-sample results, or supporting the conclusions made by other researchers in this field. The empirical analysis is conducted using event study methodology, and all data is collected from the Wharton Research Data Services (WRDS). The study looks at abnormal returns experienced by both companies in response to the acquisition announcement. The analysis is further extended to examine shareholder

[1] A non-exhaustive list of acquisitions conducted by companies in the EDA industry, including Cadence Design Systems Inc., can be found at https://semiwiki.com/wikis/industry-wikis/eda-mergers-and-acquisitions-wiki/.

reactions to a post-acquisition product announcement conducted by Cadence, as well as the long-term impact of the acquisition on Cadence's stock returns.

The results of this analysis do not find significant abnormal returns for Cadence, in both the short and long term. This finding is seen to deviate from what is found in previous literature and implies the acquisition was not value-creating or -destroying for Cadence. Instead, as no significant returns were found in either direction, evidence suggests that the acquisition was essentially a zero net present value project for the company. Contrarily, literature on target returns was supported by this study, and Verisity was found to experience significant positive abnormal returns in response to the acquisition announcement.

Section 2 of this paper provides information on the background to this case, detailing the companies' operations as well as the general timeline around the acquisition. Section 3 reviews the body of literature relevant to this case and divides said relevant literature on the basis of paper topic and main results. Section 4 uses the previous literature in the field to form testable hypotheses, and section 5 explains the methodology used to test the specified hypotheses. Section 6 supplements this information by providing further details on the data used to conduct this study. The results of the conducted analysis are broken down in section 7, and limitations to the reliability of these results are discussed in section 8. Finally, section 9 concludes the paper by providing a general summary of the results and its implications.

2. Case Background

Cadence Design Systems Inc., the acquirer, is a leading computational software company headquartered in San Jose, California, with an international office in Ireland and regional offices in U.K., India, China, and Japan. The firm specialises in electronic design technologies and engineering services, offering solutions in the form of products and services to semiconductor and system companies. Their work in electronic design automation (EDA) forms the core of the company's production of successful intelligent system design. Likely giving in to the pressure to innovate placed on the EDA industry, Cadence has made numerous attempts to gain a competitive advantage in the industry in the past. The company did this through acquisitions of companies with similar resources, with more than 70 reported merger transactions taking place since 1988. Some examples are the acquisitions of EDA companies Ambit Design Systems Inc. in 1998 and Get2Chip in 2003.

Verisity Ltd., the target, was a principal supplier in the functional verification market. Its main research and development offices were in Rosh Ha'ain, Israel, and its main executive offices were in Mountain View, California. As a global organisation, the firm also had offices in Asia, Europe, and North America. The company mainly worked to support businesses in verifying the design of electronic systems and other computational software and was recognised as a market leader in this EDA division. They held multiple proprietary and acquired products, but that of most interest to Cadence came from their acquisition of the verification company Axis Systems Inc. in 2004. Reportedly, the company had not been actively producing or building on verification technology in the twelve months before their transaction with Cadence.

The two companies first explored a possible strategic transaction in early 2002, with talks carrying well into 2003. However, these discussions did not progress beyond 'exploration'. Definitive talks began instead in August 2004, when Cadence renewed its interest in acquiring Verisity and discussions with the CEO of Verisity, Mr. Gavrielov, were resumed. Within the same month, a second EDA firm approached Verisity to express interest in a potential transaction. In response to this, in early September 2004, the CEO of Cadence, Mr. Fister, requested that the board of directors at Verisity approve the continuation of discussions exclusively with Cadence. This request was denied. The board of directors did, however, decide in late September to refrain from initiating conversation with any further entities. In early October 2004, discussions with the second company were paused, but were never resumed, making Cadence the sole company with an interest to acquire Verisity. Management at Cadence then proposed a stock offer of 0.741 shares of Cadence common stock for each Verisity ordinary share on October 28, 2004, effectively making an offer of $9.30 per ordinary share of Verisity stock. This offer was not deemed acceptable by Verisity's board of directors and was imminently declined. After further negotiations in January 2005, the firms settled on a cash offer of $12.00 per ordinary share of Verisity stock, a premium of 60.2% over the closing price of Verisity's ordinary shares on January 11, 2005. The merger was announced on January 12, 2005, once all material terms of the agreement were approved by both entities.[2]

[2] The timeline of the acquisition discussed in this paragraph was obtained through the definitive proxy statement relating to the merger published by Verisity. Further details about the merger agreement can be read at https://sec.report/Document/0001193125-05-039893/#toc.

Although acquisitions of this nature were a common occurrence in the industry, Verisity's public search for a buyer in the run up to the deal placed a spotlight on Cadence's motives to pursue a deal. Of particular note was the fact that Verisity had produced no new products in the nine months preceding the acquisition. The resources of interest to Cadence held by the company came from their work with their proprietary language e and their previous acquisition of Axis Systems, which had seen little progress in the year before this deal, as stated earlier. A second reason the acquisition was viewed with scepticism was Cadence's decision in 2003 to spin off SPW to a company they held 10–49% interest in, CoWare Inc.. This is because the functionality of SPW's technology would have proved more beneficial to designers looking for functional verification products. A postulation was therefore made at the time of the acquisition announcement that Cadence's decision to acquire Verisity was a defensive move, completed to form an entry barrier for other companies looking to make a move in the sub-industry, rather than a platform for the growth of the company itself.[3] However, on January 24, 2005, Cadence announced it would be teaming up with CoWare to leverage their SPW technology, providing suggestive evidence that the company had decided to definitively expand their product line into this sub-area of EDA solutions.

After the completion of the acquisition on April 7, 2005, Cadence announced their new 'Cadence Verification Division', led by Verisity's former President and CEO, Mr. Gavrielov. The company also appointed Verisity's founder and multiple members of senior management at Cadence to support Gavrielov in running his division. The department introduced a strategy for verification process automation (VPA) at Cadence's Design Automation Conference in June 2005, outlining plans to leverage resources gained through the Verisity acquisition. A new product family putting this plan to action was then announced on October 24, 2005, claiming to bring to fruition a major step in Cadence's plans to create 'world-class' verification solutions.

[3] The information and motives dissected in this paragraph were discussed in an article published by Electronic Design News magazine after the announcement of the acquisition, available at https://www.edn.com/why-did-cadence-buy-verisity/ for further reading.

3. Literature Review

The body of literature in mergers and acquisitions (M&As) is vast. This review considers three subsections of the previous literature available in this field. The first subsection dives into the generalised conclusions made across industries and merger types, providing a general idea of the expected outcomes of M&As for the parties involved. The second subsection starts to depart from a generalised outlook. It instead considers the impact of the contextual characteristics of a deal on its final outcome. This includes considerations such as previous M&A experience and deal-financing decisions. The final subsection places a greater focus on the post-merger outcomes of a deal. It considers the effect of the pre-merger resources of the companies involved on their post-merger innovative performance. It is essentially a measure of merger success in industries where performance indicators are heavily reliant on innovation or production output, e.g., the high-tech industry. The aim of this review is to provide a thorough understanding of the current body of knowledge on not only general M&As, but deal-specific characteristics and industry standards. However, it should be noted that a large portion of the findings included in this review come from large-sample studies. It is therefore inevitable that this clinical study occasionally deviates from outcomes that are found, on average, to be true.

3.1 *General Literature in Mergers & Acquisitions*

Previous literature has put forward consistent findings relating to the outcome of a merger for the acquirer. That is, multiple studies looking at the impact of an acquisition on the acquirer's stock returns find this effect to be negative. One early finding relating to this comes from Barfield (1998), cited by Hitt *et al*. (2005, p. 378), whose study looks at value-creation through mergers, and finds that M&As are "notorious for not creating value for shareholders". Supporting this conclusion in the same time period is Haigh (1999), who cites a study by McKinsey & Co., revealing that no more than 37% of acquirers in the U.S. perform better than their peers in stock returns, also mentioned in Hitt *et al*.'s (2005, p. 378) literature review. The review further adds to this result with Lucenko's (2000) study, who owes negative returns to acquirer shareholders to the company's inability to "effectively integrate additional acquisitions" into their firm. Taking a more technical standpoint, Hitt *et al*. (2005, p. 382) explain that an overpriced transaction leads to the firm's stock price "eventually (if not immediately) declin[ing]", allocating negative acquirer returns to incorrect target

valuations instead of inefficient management. More recent papers in this field further the conclusion that although acquirers should be able to create value through acquisitions, "[empirical] evidence suggests this is not the case" (Alexandridis *et al.*, 2011, p. 664). This statement is especially relevant for the case of Cadence and Verisity as Alexandridis *et al.*'s study focuses on evidence from the sixth merger wave of 2003–2007, of which Cadence and Verisity were a part. Their evidence suggests that deals in this period "destroyed at least as much value for acquiring shareholders as in the 1990s", pointing towards negative returns for the acquirer. Through their tests, Alexandridis *et al.* (2011, p. 665) also find that "investor sentiment thrived during the fifth merger wave" but was less positive during the sixth. This finding provides a possible explanation for the (more) negative returns experienced by acquirers in the sixth merger wave. Hence, there is strong evidence in support of a negative outcome for acquirers in any given transaction.

Deviating from findings of negative acquirer returns, Yaghoubi, Yaghoubi, Locke, and Gibb's (2016, p. 161) literature review collates previous evidence in M&As to find that the overall effect of the announcement of an acquisition for the acquirer is "economically insignificant". This conclusion effectively supports the assumption made in short-term studies that financial markets are semi-strong form efficient, and the overall effect of the acquisition on stock returns will not be significantly different from zero. This result carries on to long-term studies as well, where acquirer returns are expected to be negative or insignificant but can be highly variable based on the choice of estimation method used in the study.

Completing the Barfield (1998) quote used earlier, M&As are "notorious for not creating value for shareholders – unless one is fortunate enough to hold shares in the acquired company." This is because, as found in previous literature, on average, target firms earn positive abnormal returns in response to acquisition announcements. Supporting this statement is the Dodd (1980, p. 105) study looking at shareholder wealth. The study finds that merger announcements result in "swift and large positive market reaction[s]" for the shareholders of target firms. Dennis and McConnell (1986, p. 144) share this result, finding "statistically significant abnormal returns" for target firms' common stockholders. Acquisitions are also found to be value-increasing for the target by Bradley, Desai, and Kim (1988). Quantifying this conclusion, Wansley, Lane, and Yang (1987) find positive abnormal returns of "almost 34 percent in cash acquisitions…[and] approximately 17 percent in stock

deals", as cited by Hitt *et al*. (2005, p. 383), indicating significant positive abnormal returns for the target regardless of the acquirer's choice of financing.

3.2 *Understanding Deal Context*

Although the current body of literature provides strong indications for the general outcomes of an acquisition for both the acquirer and the acquired, the context of a deal can have a significant impact on these results, especially in a clinical study setting, where results are not averaged across a large number of firms. This section considers this effect with respect to contextual characteristics relevant to the case of Cadence and Verisity.

In light of the significant number of previous acquisitions Cadence has been part of, this review first considers what the previous literature says about the part firm experience plays in acquisition success for the acquirer. The earliest study considered is that of Kusewitt (1985), which claims that there is a "significant negative relationship between the number of previous M&A experiences and the firm performance", as cited by Yaghoubi *et al*. (2016, p. 438). However, Yaghoubi *et al*. (2016, p. 438) also find in their review that multiple studies, such as Fowler and Schmidt (1989), argue that there is a "significant positive correlation" between M&A experiences and long-term M&A performance. As Kusewitt's (1985) finding is not as well-supported as Fowler and Schmidt's (1989), it can be expected that Cadence's high number of past acquisition experience would have a positive impact on their post-acquisition performance in the long run.

A key feature of this deal is Cadence's decision to make an all-cash offer after its stock offer was declined by Verisity. There are two elements of consideration here, one is the implication that Cadence made this decision due to it being 'cash-rich', and the second is the effect of cash financing in general. With respect to the former, Harford's (1999) study suggests that acquisitions conducted by 'cash-rich firms' tend to be value-destroying. The authors also explain that this result is essentially support for Jensen's (1986) theory of the agency costs of free cash flow, which says that managers of cash-rich firms have a tendency to invest in unprofitable deals. A more recent study conducted by Devos, Kadapakkam, and Krishnamurthy (2009, p. 1206) finds evidence that supports Harford's (1999) findings. Moving on to the second element of interest, cash-financed deal are found, on average, to be perceived more positively by shareholders. This is supported by Amihud, Lev, and Travlos

(1990) and Travlos (1987), who find evidence that acquirers paying in cash achieve significantly higher returns than those who pay in stock. Hitt *et al*. (2005, p. 384) also find evidence in support of this result, showing that the stock market "responds more positively to cash transactions". They also find that acquirers prefer to pay in stock when they believe it to be overvalued. An all-cash payment may therefore signal to the market that the acquirer's stock is undervalued, suggesting positive returns for the company. On the contrary, Alexandridis *et al*.'s (2011) study looking at the sixth merger wave finds that cash-financed deals completed in this period were not value-creating for the acquirer when compared to cash-financed deals in the 1990s. However, considering that this is a relative statement instead of an absolute one, it can be inferred from the literature that the cash aspect of this deal may have a positive impact on Cadence's returns overall. Possibly adding to this positive effect is Cadence's acquisition of Verisity's CEO to lead the company's new verification division, as Graebner (2004, p. 751) finds that "acquired managers play a key role in achieving [expected] value… maintain[ing] the advantages of both integration and autonomy".

3.3 *Literature in Resources and Innovation*

Due to the heavy focus on offering market-leading technology products and services, the outcomes of deals in the high-technology industry are more often driven by the resource profiles of the companies involved. Literature in the industry therefore classes acquisitions based on how similar their resources are. It is generally found that resources that are complementary rather than highly similar lead to more favourable outcomes for the acquirer. This finding is supported by Harrison, Hitt, Hoskisson, and Ireland (1991) and more recently, King, Slotegraaf, and Kesner (2008). This is also supported by Cloodt, Hagedoorn, and Kranenburg (2006, p. 642), who suggest that companies should target firms that are "neither too unrelated nor too similar in terms of their knowledge base". Further sharing in this sentiment are Cassiman, Colombo, Garrone, and Veuglers (2005, p. 195), as they find that "M&A partners with ex-ante complementary technologies result in more active R&D performers after the M&A". However, it seems companies do not tend to heed this advice on average, as Lucking and Wagner (2015, p. 112) find that companies "value their competency and expertise in already established product categories higher", therefore staying away from non-similar product segments. This was also the case with Cadence, who acquired within an

industry in which they already held considerable share, indicating a possible negative impact on their post-M&A performance based on previous literature.

The acquirer's post-M&A innovative performance is also a subject of interest in the high-tech industry, where it is generally believed that acquisitions have a negative impact on a firm's innovative abilities. Hitt *et al*. (1996), cited by Hitt *et al*. (2005, p. 378), find that acquisitions lead to the formation of a "system that discourages innovation", i.e., a firm that grows by acquisition will continue to do so due to a fall in innovative performance. In fact, Hitt, Hoskisson, Ireland, and Harrison (1991) find a "double negative effect [of acquisitions] on 'R&D intensity' and on 'patent intensity'". This is also supported by Puranam and Srikanth (2007, p. 806), who believe disruption caused by acquisitions "hinders [the acquirer's] ability to leverage what the acquired firm 'does'". Cloodt *et al*. (2006, p. 644–646) make a similar statement, finding through previous literature that "integration of a knowledge base that is of a relatively large size can disrupt existing innovative activities", in turn having a negative effect on post-M&A innovative performance. They also cite a dominantly negative effect of cultural distance on the acquirer's innovative performance, a feature that could impact Cadence's post-M&A innovative performance considering Verisity's research offices were based in Israel.

4. Hypotheses

The implications made by the literature in this field are dissected in this section, as testable hypotheses are formed on the basis of previous findings. Through the literature, two elements of interest are identified: the stock market's reaction to the announcement of the acquisition with respect to both Cadence's and Verisity's shareholder returns, and the impact of the acquisition on the post-M&A innovative performance of the company.

The first hypothesis is concerned with abnormal returns experienced by Cadence around the announcement date. General literature in M&As points towards these returns being negative, as multiple studies find acquirers do not experience positive abnormal returns in response to acquisition announcements. This hypothesis is also supported by literature looking at company resources, as multiple researchers find that similar resource bases result in less favourable outcomes for the acquirer. On the contrary, other features of this deal may imply more positive returns for Cadence. For example, Cadence's decision of an all-cash offer is

expected to have a positive impact on the company's abnormal returns. As well as that, a positive correlation has been found between the number of previous M&A experiences for the acquirer and post-M&A performance. However, the impact of this positive correlation may not be experienced immediately and returns around the announcement date may still be negative. Therefore, as a majority of the literature points towards negative returns for the acquirer, the hypothesis is formed accordingly.

Hypothesis 1: Cadence experiences negative abnormal returns in response to the acquisition announcement

As the first hypothesis is concerned with only short-term value-creation, this study is extended to examine the long-term post-M&A performance of the firm. This hypothesis is heavily based on Yaghoubi *et al.*'s (2016) literature review, which finds from previous literature that long-term performance tends to be either negative or insignificant, and the result found is strongly dependent on the model used to estimate abnormal returns. The hypothesis is thus stated assuming the methodology used in this paper will be able to capture any significant returns present in the data.

Hypothesis 2: Cadence experiences negative abnormal returns in the long run

The third hypothesis builds on literature focusing on target returns, which finds that targets commonly see significant positive returns in response to acquisition announcements, especially in cash transactions. It is expected that this study will replicate these results and the hypothesis is based on this expectation.

Hypothesis 3: Verisity experiences positive abnormal returns in response to the acquisition announcement

Hypothesis 4 draws focus to the second element of interest: post-M&A innovative performance. Acquisitions are commonly found to have a negative impact on post-M&A innovative performance, as companies tend to find it difficult to incorporate acquired technology into their resource base, and a large number of acquisitions by the acquirer also tends to discourage innovative output by inventors. However, as innovative performance is difficult to measure directly, and patent output analysis is heavily involved, this study instead

examines shareholder reactions to the post-acquisition innovative efforts of the company. This is an important hypothesis due to the pressure the high-tech industry faces to innovate. The results from this analysis will allow for an intuitive conclusion to be made regarding whether or not the acquisition supported Cadence in achieving innovative growth.

Hypothesis 4: Cadence experiences negative abnormal returns in response to the announcement of new products leveraging Verisity resources

These hypotheses and their forthcoming results aim to provide a thorough understanding of the outcomes of this acquisition, for both Verisity and Cadence. Inevitably, the study faces certain limitations in forming definitive conclusions about the result of this acquisition, and these limitations are discussed later in the paper. Regardless, it is expected that the study will provide a better grasp of what Cadence and similar companies can expect when acquiring in the EDA industry.

5. Methodology

This study uses event study methodology to test the specified hypotheses. The empirical analysis requires the identification of an event of interest and the calculation of expected stock returns using a benchmark model. However, ultimately, the practice is broadly based on a single principle: abnormal returns.

Abnormal returns can be defined as the excess return companies earn over their expected return, typically in response to key events or announcements. This can be written as

$$Abnormal\ Return = AR_{it} = r_{it} - E(r_{it}),$$

where r_{it} is the holding period return for company i on day t, and $E(r_{it})$ is the expected return for company i on day t. Event study methodology aims to examine abnormal returns in the period of interest and reach a conclusion about their significance.

The application of the methodology differs in the length of the period of interest, i.e., short- or long-term studies. Hypotheses 1, 3 and 4 will be tested using a short-term study as they test the immediate or proximate market reactions to the announcement of the acquisition. Hypothesis 2 will be tested using a long-term study in order to determine the long run impact of the acquisition on Cadence's returns.

The first step in any event study, short- or long-term, is identifying an event of interest and its respective event date. In this clinical study, the main event of interest is the announcement of Cadence's acquisition of Verisity. The event date is identified as the day the acquisition was officially announced by both parties, January 12, 2005, i.e., January 12, 2005, is event day 0 for hypotheses 1, 2, and 3. Hypothesis 4 considers a second event, Cadence's announcement of a new product family leveraging Verisity's resources. This took place on October 24, 2005, approximately 6 months after the completion of the acquisition, i.e., October 24, 2005, is event day 0 for the second event of interest.

5.1 *Short-term Event Study Methodology*

Short-term event study methodology first requires a distinction between the estimation period (EP) and the test period (TP). The TP is the period in which abnormal returns are calculated. "In practice, [it includes] at least the day of the announcement and the day after the announcement" (MacKinlay, 1997, p. 15). This practice allows for the methodology to account for late reactions or "price effects which occur after the stock market closes on the announcement day" (MacKinlay, 1997, p. 15). Taking this into consideration, and assuming a semi-strong form efficient market that adjusts security prices to incorporate public information instantly, the test periods respective to the short-term hypotheses are specified as follows.

> *Hypothesis 1*: abnormal returns are calculated across two test periods in order to examine the robustness of the results,
>
> 1. January 12, 2005, to January 13, 2005, inclusive
> 2. January 12, 2005
>
> *Hypothesis 3*: January 12, 2005, to January 13, 2005, inclusive
>
> *Hypothesis 4*: October 24, 2005, to October 25, 2005, inclusive

The estimation period is typically a 250-day period in which the benchmark model is estimated. Borrowing Strong's (1992, p. 538) definition, it is chosen to be "close to the TP but [a period] in which the disclosure events under study are expected to have no effect on security prices". The EP is chosen to end twelve days before the announcement of the event, as "leakage of inside information [that can have an effect on security prices] is a pervasive problem occurring at a significant level up to 12 days prior to [the announcement of the

event]" (Keown and Pinkerton, 1981, p. 855). An estimation period of January 1, 2004, to December 31, 2004, inclusive is established for this paper's short-term study.

The benchmark model is then chosen to obtain efficient estimates of expected returns for the TP so that abnormal returns can be calculated with confidence. There have been multiple choices for this model in previous event studies, the most common of which are discussed briefly as follows.

a. The Mean Adjusted Return model estimates the expected return as the average of the realised returns over the estimation period, i.e.,

$$E(r_{it}) = \bar{r}_{i\tau}, \qquad t \in TP, \tau \in EP$$

b. The Market Adjusted Return model estimates the expected return as the return on the market index on the same day, i.e.,

$$E(r_{it}) = r_{mt}, \qquad t \in TP$$

c. The Capital Asset Pricing Model (CAPM) is a widely used method in Finance to determine the expected rate of return of a security based on a its relationship with systematic risk. It estimates model parameters in the EP and uses these parameters to calculate expected return in the TP, i.e.,

$$E(r_{it}) = r_{ft} + \hat{\alpha} + \hat{\beta}\left(r_{mt} - r_{ft}\right), \qquad t \in TP$$

d. The Fama-French Three-Factor Model is a popular asset-pricing model that expands on the CAPM to include additional risk factors. It also estimates the model's parameters in the EP and uses the estimates to calculate expected returns in the TP, i.e.,

$$E(r_{it}) = r_{ft} + \hat{\alpha} + \hat{\beta}\left(r_{mt} - r_{ft}\right) + \hat{\gamma}HML_t + \hat{\sigma}SMB_t, \qquad t \in TP$$

e. The Market Model is the model most frequently used for short-term event studies. It models expected returns as a function of the systematic risk the respective security faces, i.e., the relationship between stock returns and market returns for a chosen EP. Similarly to models c and d, model parameters obtained in the EP are used to calculate expected returns in the test period, i.e.,

$$E(r_{it}) = \hat{\alpha} + \hat{\beta}r_{mt}, \qquad t \in TP$$

Previous literature looking at the validity of these models in providing reliable parameter estimates find the market model to be sufficient in explaining stock returns. Strong's (1992, p. 541) paper on modelling abnormal returns states that "a first requirement for the use of any methodology is that it be well-specified". The author also cites Brown and Warner's (1980, p.

205) study on measuring security price performance, which finds that "a simple methodology based on the market model performs well under a wide variety of conditions". As well as that, MacKinlay (1997, p. 18) identifies the mean adjusted model and the market model as two common choices for event studies, describing the market model as a "potential improvement" over the former, due to its "increased ability to detect event effects", which comes from a reduced abnormal return variance. The short-term event study in this paper is therefore conducted using the market model. More specifically, an ordinary least squares (OLS) regression using daily data from the period January 1, 2004, to January 31, 2004, inclusive is run on the regression model

$$r_{it} = \alpha + \beta r_{mt} + \varepsilon_{it},$$

where r_{it} is the return on the stock on day t and r_{mt} is the return on the market portfolio on day t. Ideally, the market portfolio would contain all financial assets available in the market. However, this breadth of data is typically unavailable, and a comprehensive proxy is used. Throughout this study, the S&P 500 is the stock market index used as a proxy for the market portfolio.

It should be noted that the benchmark model parameter estimates can be biased if stocks are thinly traded, i.e., not traded on any given day within the estimation period. However, trading volumes across the estimation period were examined for both stocks, and the thin trading problem was not found. Therefore, OLS estimates of the chosen market model are expected to be unbiased and efficient.

Parameter estimates, $\hat{\alpha}$ and $\hat{\beta}$, are obtained through the OLS regression, and are then used to calculate expected returns in the selected test periods, as seen in the formula following.

$$E(r_{it}) = \hat{\alpha} + \hat{\beta} r_{mt}, \qquad t \in TP$$

Estimation of expected returns across the periods of interest allow the study to progress into the next stage: obtaining values for abnormal returns in the test periods,

$$AR_{it} = r_{it} - E(r_{it}), \qquad t \in TP$$

For test periods that include multiple days, these returns are cumulated to obtain a single measure of abnormal returns across the period of interest.

$$CAR_{it=t_1:t_2} = \sum_{t=t_1}^{t_2} AR_{it}\,, \qquad t \in TP$$

As the final step in the short-term empirical study of the impact of the acquisition on shareholder wealth, the significance of the AR and the CAR is tested for each hypothesis, and definitive conclusions about the results of the study are formed. The standard t-statistics for performing significance tests are

$$t\text{-}statistic\ for\ AR_{it} = \frac{AR_{it}}{s.e(AR_{it})},$$

$$t\text{-}statistic\ for\ CAR_{it} = \frac{CAR_{it}}{\sqrt{T_{TP}}s.e(AR_{it})},$$

where the market model residual standard error is used as an estimate for the abnormal return standard error, $s.e(AR_{it})$. MacKinlay (1997, p. 24) discusses "modifications to the basic approach" for calculating the t-statistic for hypothesis tests. Such reforms are needed due to issues with using the model residual standard error as an estimate for the abnormal return standard error. This is because the figure will typically not be bigger than the standard error of the abnormal return, and will therefore inflate the standard t-statistic, possibly leading to incorrect conclusions. MacKinlay (1997, p. 24) specifies that "standardization", such as that found in James Patell's (1976) method, "[leads] to more powerful tests". This method makes use of the 'Patell z statistic', identified as v_{it}. The formulas below describe the required calculation to obtain a t-statistics for ARs and CARs and their respective distributions.

$$t\text{-}statistic\ for\ AR_{it} = v_{it} = \frac{AR_{it}}{se\sqrt{C_{it}}}, \qquad t \in TP \sim t(T_{EP} - 2)$$

$$t\text{-}statistic\ for\ CAR_{it} = \kappa_i = \frac{\sum_t v_{it}}{\sqrt{T_{TP}}}, \qquad t \in TP \sim t(T_{EP} - 2)$$

And the components of the formulas for the required t-statistics are computed as seen below.

$$se = \sqrt{\frac{1}{T-2}\sum_{\tau \in EP} e_{i\tau}^2}, \qquad \tau \in EP$$

$$C_{it} = 1 + \frac{1}{T} + \frac{(r_{mt} - \bar{r}_m^{EP})^2}{\sum_{\tau \in EP}(r_{m\tau} - \bar{r}_m^{EP})^2}, \qquad t \in TP, \tau \in EP$$

r_{mt} represents returns on the market portfolio on day t of the TP, $r_{m\tau}$ represents returns on the market portfolio on day τ of the EP, $\bar{r}_m^{EP}$ is the average return on the market across the EP, and $e_{i\tau}^2$ is the squared model residual on day τ of the EP.

To form a conclusion about a certain hypothesis, a distinction between the null hypothesis and the alternative hypothesis has to be made. By definition, the null hypothesis, referred to as H_0,

is the hypothesis researchers aim to 'nullify'. It is essentially a direct contradiction of the original hypothesis. The alternative, H_A, on the other hand, is a restatement of the original hypothesis. The null and alternative hypotheses for the short-term study are defined below in terms of the expected direction of the CAR.

Hypothesis 1:

$$H_0: CAR \geq 0$$
$$H_A: CAR < 0$$

Hypothesis 3:

$$H_0: CAR \leq 0$$
$$H_A: CAR > 0$$

Hypothesis 4:

$$H_0: CAR \geq 0$$
$$H_A: CAR < 0$$

The above are examples of one-sided tests, where a direction in which the results are expected to move is specified. In order to form a conclusion, a critical value is identified using the degrees of freedom from the regression and a chosen level of significance. The level of significance is typically chosen to be 5%, and the critical values for this test were obtained through statistical software for accuracy. Where the t-statistic is larger than the critical value, the null hypothesis is rejected, and sufficient proof for the alternative hypothesis to be true is found. Alternatively, a p-value smaller than the chosen level of significance allows for the same conclusion to be reached.

5.2 *Long-term Event Study Methodology*

For long-term event studies, there are two main approaches to measuring abnormal returns: the Asset-pricing Model approach and the Buy-and-Hold Abnormal Return (BHAR) approach. Both approaches have their strengths, however, this study uses the asset-pricing model due to its strength in testing statistical significance in a clinical study setting. The BHAR method, although insightful, can only be used for inference in large sample studies, as in small samples its underlying distribution is unknown. In fact, in a large-sample study, it would be preferred, due to the fact that it reflects the true wealth effect to the investor during

the TP, while the asset-pricing model does not. However, in this case, the BHAR method would be impractical.

Similarly to short-term study methodology, the asset-pricing model approach can also differ in how returns are modelled based on the risk factors accounted for. This choice is a lot more important in a long-term study, as data is collected on a monthly basis, and any small pricing errors can compound over long horizons. In their study on common risk factors, Fama and French (1993, p. 54) find that "residuals from three-factor regressions that also use SMB and HML will do a better job of isolating the firm-specific components of returns", where SMB accounts for size risk and HML accounts for value risk. This leads us to the widely-used Fama French three factor model

$$r_{it} - r_{ft} = \hat{\alpha} + \hat{\beta}\left(r_{mt} - r_{ft}\right) + \hat{\gamma}SMB_t + \hat{\sigma}HML_t + e_{it}, \qquad t \in TP,$$

where r_{ft} is the risk-free interest rate in month t, i.e., the one-month treasury bill rate, r_{mt} is the return on the market portfolio in month t, SMB_t is the return on the Small-Minus-Big factor portfolio in month t, and HML_t is the return on the High-Minus-Low factor portfolio in month t.

Another key difference in the modelling procedures of a short-term and long-term study is the distinction between the EP and the TP. In a long-term study, this distinction is not required. Instead, the model is run entirely over the test period, typically taken to be 3–5 years from the start of the event, and abnormal returns across the TP are represented by the intercept, $\hat{\alpha}$, better known as Jensen's Alpha. This figure is essentially an estimation of the monthly abnormal returns experienced by the company. In this study, two test periods are considered to test hypothesis 2:

1. 3-year TP: January 2005 to January 2008 inclusive
2. 5-year TP: January 2005 to January 2010 inclusive

If an event does not have a long-term impact on the company's returns, the Jensen's alpha will not be significantly different from zero. Its statistical significance can be tested directly using the standard intercept t-statistic or p-value found in regression output. If the t-statistic (p-value) is greater (smaller) than the critical value (level of significance), the null hypothesis is rejected. The null and alternative hypotheses for the long-term study are stated below.

Hypothesis 4:

$$H_0: \hat{\alpha} \geq 0$$
$$H_A: \hat{\alpha} < 0$$

The results in the section forthcoming consider the hypotheses established for the short- and long-term studies and support the formation of conclusions accordingly.

6. Data

Table 1
This table describes the data components collected in order to conduct the empirical study. Component returns refer to holding period returns, calculated as

$$HPR_{it} = (p_{it} + d_{it} - p_{i,t-1})/p_{i,t-1},$$

where p_{it} is price at time t, $p_{i,t-1}$ is price at time $t-1$, and d_{it} is dividend at time t. ST refers to data collected for the short-term study and LT refers to data collected for the long-term study. The 'Period' column makes a distinction between data collected for the test period (TP) vs. the estimation period (EP), and dates in the 'Date Range' column are in the DD/MM/YYYY format.

Component	Study	Period	Frequency	Date Range
Cadence Design Systems, Inc. Stock Returns	ST	EP	Daily	01/01/2004–31/12/2004
	ST	TP	Daily	12/01/2005–13/01/2005
	ST	TP	Daily	24/10/2005–25/10/2005
	LT	TP	Monthly	31/01/2005–29/01/2010
Verisity Ltd. Stock Returns	ST	EP	Daily	01/01/2004–31/12/2004
	ST	TP	Daily	12/01/2005–13/01/2005
Market Index (S&P500) Returns	ST	EP	Daily	01/01/2004–31/12/2004
	ST	TP	Daily	12/01/2005–13/01/2005
	ST	TP	Daily	24/10/2005–25/10/2005
Risk-free Interest Rate (rf, one-month treasury bill rate)	LT	TP	Monthly	31/01/2005–29/01/2010
Excess Return on the Market (S&P500–rf)	LT	TP	Monthly	31/01/2005–29/01/2010
SMB Factor Portfolio Returns	LT	TP	Monthly	31/01/2005–29/01/2010
HML Factor Portfolio Returns	LT	TP	Monthly	31/01/2005–29/01/2010

All data used in this empirical study was collected from the Wharton Research Data Services (WRDS). The short-term study conducted for hypotheses 1, 3, and 4 required data of daily frequency, while the long-term study conducted for hypothesis 2 required data of monthly frequency. The components collected, along with the respective dates within which the data are collected, and the study they belong to, are specified in Table 1. Data concerned with stock prices and indices were downloaded from the Center for Research in Security Prices, LLC (CRSP) database, and data for the Fama-French asset-pricing model were downloaded from the Fama-French Portfolios & Factors database within WRDS.

7. Results

7.1 *Short-term Event Study Results*

Table 2 reports results of market model regressions for both Cadence and Verisity. Though coefficient values for the returns of the S&P 500 market index for both models are significant, the r-squared values of the models are low. By definition, these figures suggest the market model does not do a very good job at explaining Cadence and Verisity's stock returns, possibly posing a limitation to this analysis and the validity of its results. The consequences of this limitation are discussed in detail in the next section.

Table 2

This table reports OLS regression coefficients from the estimations of the market model,

$r_t = \alpha + \beta r_{mt} + \varepsilon_{it}, \quad t \in EP,$

where r_t represents the return on the stock for which the regression is run, and r_{mt} represents the return on the market index, S&P 500. Regressions for both stocks, Cadence and Verisity, are run independent of each other. P-values for each estimate are reported in parentheses under the respective figure, and parameters significantly different from zero at the 10%, 5%, and 1% significance levels are marked with one, two, or three asteriskes respectively. Descriptive figures for each model are included at the end of the table. All figures are reported to three decimal places.

	Coefficients	
r_t	*CADENCE*	*VERISITY*
Intercept	-0.001	-0.002
	(0.213)	(0.450)
S&P 500 Return	1.165***	0.789***
	(0.000)	(0.006)
Model Standard Error	0.017	0.032
Multiple R-squared	0.196	0.029
Observations	252	252

Table 3 reports abnormal return and t-statistic values for each hypothesis in the short-term event study. The results for hypothesis 1 show that Cadence does experience negative abnormal returns in the two-day test period. However, the reported t-values show that this result is insignificant. It can also be noted that when examined only on day 0, Cadence experiences positive returns, though this result is also not significant. This positive CAR can possibly be owed to late reactions to the announcement of the acquisition. However, the figures also suggest that the announcement of the acquisition was almost immediately incorporated into the company's stock price, as the change in CAR is not significant, and the conclusion reached does not change with either test period. This is preliminary support for the assumed semi-strong form efficient financial market.

Table 3

This table reports the cumulative abnormal return (CAR) in the test period (TP) respective to each hypothesis in the short-term study. It also reports standard and Patell t-statistics respective to each CAR. The TP in which each CAR was calculated is specified, and where the TP is [0], the CAR is the abnormal return on that day. CARs are reported to four decimal places, and t-statistics are reported to two decimal places. Critical values for a one-sided test and 250 degrees of freedom are reported at the end of the table. CARs significantly different from zero at the 10%, 5%, and 1% significance levels are marked with one, two, or three asteriskes respectively.

	TP	CAR	Standard t-statistic	Patell t-statistic
Hypothesis 1	[0]	0.0129	0.78	0.55
Hypothesis 1	[0, 1]	-0.0004	-0.02	-0.01
Hypothesis 3	[0, 1]	0.5514***	12.30	10.02
Hypothesis 4	[0, 1]	-0.0053	-0.23	-0.19
Level of Significance	10%	5%	1%	
Critical Value	±1.28	±1.65	±2.35	

Due to the insignificance of the figures reported, a definitive conclusion about the direction of Cadence's returns cannot be reached. Therefore, sufficient support for hypothesis 1 is not found, and the analysis concludes that Cadence does not experience negative abnormal returns in response to the acquisition announcement. Although a majority of the literature pointed towards an expectation of significant negative returns for Cadence, this conclusion finds support for Yaghoubi *et al.*'s (2016) finding in their literature review, where they state that the overall effect of the announcement of an acquisition on acquirer returns is economically insignificant. The result of this study could also be viewed as being 'less negative' than usual. Considering the literature discussed while forming the hypothesis, although negative abnormal returns were expected, the result of insignificant returns may have been due to a counteracting positive impact of the cash aspect of the deal, the number of acquisitions conducted by Cadence previously, and the 'acquired manager'. This evidence possibly suggests investors felt this acquisition would be more value-creating for Cadence than it typically is for acquirers in the industry due to the contextual features of the deal.

Hypothesis 3 is also examined through the results reported in table 3. Both standard and Patell t-statistics suggest the positive cumulative abnormal return found for Verisity is significant. This provides support for hypothesis 3, allowing for the conclusion that Verisity did experience positive abnormal returns in response to the announcement of the acquisition. This finding is in line with what is seen in previous literature and in industry, where acquisitions are found to be a profitable project for target firms shareholders.

Hypothesis 4, looking at shareholder reactions to the post-acquisition innovative efforts of the combined firm, is also not supported by the results in table 3. Although the cumulative abnormal return in the test period was negative as hypothesised, the figure was not found to be significant. However, this is an especially intuitive result considering the many companies in the industry that acquire as a response to pressure to innovate. The finding of insignificant abnormal returns in response to a product announcement provides suggestive evidence that the acquisition did not help Cadence reach this goal. It also supports previous literature in mergers and acquisitions, as a lack of 'value creation' for acquirers is a common finding. However, considering the body of literature that finds evidence of a reduced post-M&A innovative ability in the high-tech industry, this result of insignificant returns may be a product of imperfect methodology rather than a lack of impact of the acquisition on innovative performance. More robust estimates of innovative performance may include the analysis of company-wide or verification-specific patenting information. As the variable of interest in this analysis was shareholder returns, the resulting conclusion is that Cadence did not experience negative abnormal returns in response to the product announcement leveraging Verisity's resources. In other words, their products leveraging Verisity's resources were not viewed favourably by shareholders. No direct conclusion about the firm's post-M&A innovative performance is made.

7.2 *Long-term Event Study Results*

Table 4 provides coefficient estimates for the long-term study regressions. These figures prove to be an extension of the result found for hypothesis 1, as intercept values in the 3-year and the 5-year period are insignificant. The analysis therefore does not find support for hypothesis 2, leading to the conclusion that Cadence does not experience negative abnormal returns in the long run. This result supports the latter of Yaghoubi *et al.*'s (2016) finding of either negative *or* insignificant returns for acquirers in the long run. Looking at the results of hypothesis 1 and hypothesis 2 together, a conclusion can be reached that Cadence's acquisition of Verisity did not have a significant impact on the company, in the short or long run.

Table 4

This table reports OLS regression coefficients for the estimations of the Fama-French three factor model regressions in the 3-year and 5-year test periods,

$r_t - r_{ft} = \alpha + \beta(r_{mt} - r_{ft}) + \gamma SMB_t + \sigma HML_t + e_{it}, \quad t \in TP,$

where $r_t - r_{ft}$ is the excess return on Cadence's stock, $r_{mt} - r_{ft}$ is the excess return on the market, SMB_t is the return on the Small-Minus-Big portfolio, and HML_t is the return on the High-Minus-Low portfolio. P-values for each estimate are reported in parentheses under the respective figure, and parameters significantly different from zero at the 10%, 5%, and 1% significance levels are marked with one, two, or three asteriskes respectively. Descriptive figures for each model are included at the end of the table. All figures are reported to three decimal places.

	Coefficients	
	3-YEAR TP	*5-YEAR TP*
Intercept	-0.011	-0.008
	(0.357)	(0.444)
Excess Return on the Market	2.142***	1.529***
	(0.001)	(0.000)
SMB Return	0.058	0.863*
	(0.932)	(0.093)
HML Return	-0.466	-1.084*
	(0.513)	(0.007)
Model Standard Error	0.069	0.085
Multiple R-squared	0.445	0.460
Observations	37	61

Reiterating the conclusions made, two key results are found. The first is that the acquisition was essentially a zero net present value project for Cadence, and there is support for the short-term study assumption of semi-strongly efficient financial markets. The second is that acquisitions result in significant gains in wealth for the target firm's shareholders. Though it is difficult to generalise a result from a clinical study, this result can be seen to support the large body of literature that finds positive abnormal returns for target firms.

8. Limitations and Further Research

The analysis conducted in this paper faces certain methodological and interpretative limitations. Beginning with the conclusions made in this paper, it is clear that although intuitive results have been found, these results cannot be easily generalised to other high-technology companies. This is because this was a clinical study, and generalisation commonly requires averaging from large-sample results, which would ensure the conclusions made were

applicable to a range of cases, a claim that cannot be made for this study. However, this limitation is common to all clinical studies, and does not mean the conclusions made cannot be insightful. Conclusions made in this paper allow for a better understanding of the variability of outcomes in mergers and acquisitions as compared to previous findings — especially in the high-tech industry. They also provide support for previous literature in the field that has found similar results.

The methodology used in this paper, although popular, poses certain restrictions on the strength of the results found. The first points of interest are the low r-squared values of the market models from the short-term study. It could be the case that the insignificant results found for Cadence's cumulative abnormal returns are owed to the inability of the market model to explain Cadence's stock returns. If this is the case, the conclusions made in this paper cannot be considered a good representation of the outcome of this acquisition. A possible explanation for this low r-squared value could be the volume and frequency of acquisitions conducted by Cadence. The company's regular acquisitions of firms in the industry make it difficult to specify an estimation period for the market model that is not affected by events unconnected to Cadence's acquisition of Verisity. This in turn means parameter estimates have larger biases and are unable to explain Cadence's returns efficiently. This could possibly be improved by extending the study to consider more comprehensive asset-pricing models. For example, repeating the short-term study using the Fama-French three factor model as the benchmark may prove useful in confirming the conclusions made. Further, the high frequency of acquisitions by Cadence also make it difficult to isolate the effect of this acquisition on the firm's stock returns. To reiterate, abnormal return calculations in the test periods may include effects from other acquisitions, and the impact of Cadence's acquisition of Verisity would not be accurately measured. This problem is especially critical for the long-term study, as test periods are significantly longer and inevitably include the acquisitions of other companies as well as other key events.[4] Therefore, the true values of the Jensen's alpha in the test periods may not be insignificant.

[4] As this study was conducted within the test period of 2005–2010, the validity of the long-term study results may have been affected by the financial crisis of 2007–2008. However, this study expects that any such effect would have been incorporated into the model through the market index, and key events affecting the validity of the results are those that are specific to Cadence or the industry it operates in.

In empirical studies, the post-acquisition innovative performance is typically measured through the analysis of patent output. However, this information is not easily acquired and has only been used in large-sample studies, such as that of Cloodt *et al*. (2006). Its validity in a clinical study setting is therefore not known. As this paper's focus was on shareholder wealth, the analysis instead considered shareholder reactions to Cadence's innovative efforts after the acquisition. Due to this, results found do not allow for a direct conclusion to be made about the post-M&A innovative performance of the company. The limitation therefore arises from the finding's inability to support results found in previous literature that looks at post-M&A innovative performance. However, the analysis is still insightful in showing the lack of value creation for acquirers in the industry.

A second limitation to the analysis of post-M&A innovative performance is the timing of the product announcement. As the product announcement takes place in October 2005, it is difficult to confirm whether or not parameter estimates obtained from the January 2004 to December 2004 period are applicable to the test period. This is because the parameters may have changed during the ten months between the estimation and test periods. If this were the case, the true effect of the product announcement on acquirer returns would remain unknown.

The limitations discussed in this section are important considerations in confirming the accuracy of the results found in this paper. However, this significance also provides an opportunity for further research or analysis. Seeing as Cadence is one of many key market players in the high-tech industry, mergers conducted by competitors like Synopsys Inc. provide an opportunity for further analysis of the impact of high-tech acquisitions on shareholder wealth. Conducting an empirical analysis on a wider range of EDA firms would allow for a better understanding of whether, on average, consolidation is a successful approach for growth in the industry. This research would provide conclusions generalisable to similar companies in the industry, building not only on this study, but also studies discussed in Rossi, Tarba, and Raviv's (2013) literature review of M&As in the high-tech industry. Also, as innovation is a key performance indicator in the high-tech industry, a large-sample study in this field could be extended to include the analysis of post-acquisition innovative performance. This would provide an opportunity to use Cloodt *et al*.'s (2006) methodology. Results from such a study would also be important in examining whether similar findings to previous studies can be obtained. This extension would be a vital addition to the body of

literature in the EDA industry, as there is not yet a wide range of studies supporting this analysis.

9. Conclusion

This paper looked at the short- and long-term effect of an acquisition in the high-tech industry on shareholder wealth. The study used event study methodology to conduct the required analysis. This included employing the market model to explain stock returns in the short run and the Fama-French three factor model to explain stock returns in the long run. Cumulative abnormal returns were examined to reach a conclusion about the significance of the deviation of stock returns from market expectations in response to key announcements. Cadence's CARs were not found to be significant, and the study failed to reject the null hypotheses for hypothesis 1 and hypothesis 4. Similarly, the Jensen's alpha in the long-term study was insignificant for both test periods, and hypothesis 2 was not supported by data. However, Verisity's CAR around the announcement date was found to be significant and was accepted as sufficient evidence in support of hypothesis 3.

Two key results were found through the conclusions made in this study:

1. Acquisitions are a zero net present value project for acquirers, as suggested by Yaghoubi *et al*. in their 2016 review of studies in mergers and acquisitions.
2. Shareholders of target firms tend to benefit from the announcement of an acquisition.

These results add to the vast body of literature in mergers and acquisitions and provide a starting point for further analysis in the industry. The methodological limitations of the paper provide an opportunity to extend the study and reach more generalisable conclusions about the outcome of high-tech acquisitions. As the results of this paper deviate from common findings of the impact of an acquisition for acquirers, the paper provides an alternative perspective to what acquirers in the industry can expect. Additionally, the paper finds support for the assumed semi-strongly efficient financial market.

On the whole, this paper achieves its goal of providing a better understanding of the outcome of the acquisition for Cadence and Verisity, finding that the acquisition was not value-creating for Cadence. Although conclusions are not generalisable, the study is an insightful step

towards depicting the effect of acquisitions undertaken in a high-pressure industry on a company's long-term success.

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