The Best of Two Worlds: Integrating Statistical and Judgemental Forecasting

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Preface
This project ends my career at the Eindhoven University of Technology. During this six year period I frequently asked myself why to spend that much time studying besides having a lot of fun. Now, I am convinced that I acquired an extensive amount of valuable knowledge during this period and gained skills that are truly relevant for a professional career as well as my personal life.

My university career would not have been possible without the help and inspiration of many people. However, I would like to thank some people in particular. First, my university supervisors, Jeroen Schepers, who supported me for one and half year, and Bob Walrave who provided useful recommendations. Second, my organizational supervisor, Roy van Helden, who gave me the opportunity to learn and apply my knowledge in an organizational setting. Third, my parents who supported and motivated me to study. Fourth, my friends who provided me with pleasant distraction. Finally, my girlfriend Nicole and my recently born daughter Yara who make my life even more worthwhile.

Starting six year ago as rookie. Now I am ready for the next step: a professional career!
Abstract
This research examines the integration of statistical and judgemental forecasting, focusing on the strengths and weaknesses of the integration. A study of demand forecasting in an organizational setting is reported. I show that statistical forecasts are almost continuously judgementally adjusted. Most of these adjustments are small and or positive and these often reduced accuracy and wasted management time. However, large and especially large negative adjustments, based on reliable information, improve accuracy. These findings show how to effective combine statistical and judgemental forecasting to ensure optimal forecasting performance. The reliability of the contextual information that forecaster provide to adjust statistical forecasts must be clearly evaluated to make sure that only those adjustments are made that minimize the forecast error. This can be established by including feedback to the judgemental input. In this way, not only demand forecasting accuracy can be improved, but organizational learning and consensus within the organization can be achieved as well.
Management Summary
The settings of the online market are changing tremendously. It is becoming more and more competitive and customers are getting high expectations of customer service. Among others, customers are expecting faster product delivery and competitors are challenging Vistaprint’s pricing and product quality. However, Vistaprint wants to exploit their disruptive business model and reach their big hairy audacious goal of 30 million loyal customers by the year 2020.

To achieve the audacious goal Vistaprint wants to improve their forecasting performance to both satisfy customer needs and decrease costs. To this end the following research question is formulated.

How can Vistaprint optimize the use of statistical and judgemental forecasting to minimize the forecast error?

An overview of the conceptual model and the accompanying hypotheses to answer the research question is shown in Figure 0.1.
To test the hypotheses there is selected forecast data of 13 product groups in the European market for a time period of 33 months. Resulting in 429 measurements. The results of the hypotheses are shown in Table 0.1.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Outcome</th>
<th>Insight</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1. The statistical forecasts selected for adjustment are those most in need of improvement</td>
<td>Supported</td>
<td>Forecasters are able to adjust the statistical forecast that are most in need for judgemental input. Indicating that forecasters have knowledge that is not captured in the statistical model.</td>
</tr>
<tr>
<td>H2. Judgemental adjustments of statistical forecasts improve forecast accuracy.</td>
<td>Supported</td>
<td>Judgemental adjustment is of value to the forecast process (i.e. judgemental adjustment improves accuracy).</td>
</tr>
<tr>
<td>H3. Negative judgemental adjustments of statistical forecasts improve forecast accuracy more than positive judgemental adjustments of statistical forecasts.</td>
<td>Supported</td>
<td>Negative judgemental adjustments are more effective than positive judgemental adjustments.</td>
</tr>
<tr>
<td>H4. The sizes of the judgemental adjustments are positively associated with an improvement in accuracy</td>
<td>Supported</td>
<td>Larger judgemental adjustment should be continued while smaller judgemental adjustment should be more careful considered before carried out.</td>
</tr>
<tr>
<td>H5. Judgemental forecast adjustment improves the forecast accuracy more under high volatility than low volatility conditions.</td>
<td>Supported</td>
<td>Under stable demand patterns, statistical forecasts outperform judgementally adjusted forecasts.</td>
</tr>
<tr>
<td>H6. The judgementally adjusted forecasts introduce positive bias.</td>
<td>Supported</td>
<td>Organizational politics should be kept in mind when adjusting and interpreting the adjusted forecast.</td>
</tr>
<tr>
<td>H6a. The negatively judgementally adjusted forecasts are not biased.</td>
<td>Partially Supported</td>
<td>For negatively judgementally adjusted forecasts bias is not an issue.</td>
</tr>
<tr>
<td>H6b. The positively judgementally adjusted forecasts are positively biased.</td>
<td>Supported</td>
<td>When positive adjustments are applied correction for bias should be considered.</td>
</tr>
</tbody>
</table>

These empirical findings show how to effectively combine statistical and judgemental forecasting to minimize the forecast error. Forecasters should avoid small adjustments, adjustments of stable demand patterns, and positive adjustments should be corrected for organizational politics. To establish this the forecasting process should be changed. The forecast setup step should be provided with feedback that makes it possible to modify the statistical models or model parameters based on reliable information to improve its...
effectiveness. Next, the forecast activity step should be provided with feedback. To provide insight into the effectiveness of the judgemental adjustments. This is in line with the proposed forecasting framework as shown in Figure 0.2. Vistaprint is currently missing the red dotted line. The feedback can be achieved by including a support system that mitigates the negative consequences of judgemental adjustment. This support system should overcome the fallibilities of human judgement and therefore improve the effectiveness of judgemental adjustment. It should provide facilities that: reduce the demands on memory; provide guidance on similarity; and provide information to support the judgemental adjustment. This could be established by including a centralized database that includes past reasons for adjustments and their results (i.e. effectiveness of adjustment). As such, only the adjustments that are effective will remain. Furthermore, as a result of the feedback organizational learning and consensus within the organization can be achieved as well.

![Figure 0.2 Forecasting Framework (based on: Silver et al., 1998)](image)

Finally, I recommend to use the following evidence-based guidelines to optimize the use of statistical and judgemental forecasting to minimize the forecast error.

- A small committee should be responsible for the judgemental input;
- The membership should include an individual with a broad organizational perspective as well as representatives from all departments affected by the forecast;
- The membership should include an individual that is knowledgeable in the statistical aspects of forecasting;
- The committee should be concerned with a properly defined set of products;
- Starting point should be the aggregated (statistical) forecast across the set of products;
- The committee should be able to easily adjust the aggregate forecast;
- The judgemental process should be well structured;
- Reasons for judgemental adjustments should be structurally documented;
- There should be given feedback to the performance of the judgemental input.
- Balance the costs of forecast errors made versus the costs of generating forecasts.

If Vistaprint sticks to those recommendations, the statistical and judgemental forecasting can be optimized to minimize the forecast error as part of achieving the audacious goal of 30 million loyal customers by the year 2020.
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1. Introduction

“I think there is a world market for maybe five computers”. This 1943 quote, assigned to former IBM CEO Watson, is typically used to demonstrate the difficulty of predictions. However, demand forecasting is of tremendous importance for organizations. For instance, manufacturing decisions on raw material procurement; logistic decisions on distribution; marketing decisions on marketing budgets; and finance decisions on corporate budgets are based on forecasts. Given this breadth of decisions, any forecast error has definite company-wide consequences that can result into significant bottom line consequences (Kahn, 2002). Moon, Mentzer, and Smith (2003) state that improved demand forecasting accuracy can lead to significant monetary savings, greater competitiveness, enhanced channel relationships, and greater customer satisfaction. Company management is therefore very interested in finding ways to improve the product forecast effort, and thereby minimize forecast error (Kahn, 2002). This already implicates that demand forecasting in organizational settings deserves attention and is worthwhile researching.

1.1 Problem context

The organization under investigation, Vistaprint, is the leading online provider of marketing products and services to small businesses around the globe in low volumes and at low costs. The settings of the online market are changing tremendously. It is becoming more and more competitive and customers are getting high expectations of customer service. Among others, customers are expecting faster product delivery and competitors are challenging Vistaprint’s pricing and product quality. However, Vistaprint wants to exploit their disruptive business model and reach their big hairy audacious goal of 30 million loyal customers by the year 2020\(^1\). Where loyal customers are defined as customers who return and buy products from Vistaprint’s portfolio again.

As part of achieving the audacious goal Vistaprint wants to improve their forecasting performance (i.e. minimize forecast error) to both satisfy customer needs and decrease costs. Vistaprint is interested in how to improve their forecasting performance. I consider the product introduction of personalizable iphone-cases and analyze the current forecasting process to identify improvement possibilities.

1.1.1 Problem case: Iphone-case introduction

Iphone-cases were introduced to the market at November 2012. Marketing has initially provided a forecast that is far below the actual demand\(^2\), as shown in Figure 1.1 for the Iphone-4 case.

\(^1\) Currently, Vistaprint has approximately 15 million loyal customers.

\(^2\) Actual demand is based on Vistaprint’s manufacturing database.
To provide a better understanding of the consequences of this inaccurate forecast, I first outline how forecast inaccuracies are currently detected and define the difficulties of inaccurate forecasting for the Iphone-4 cases in specific.

**Forecast inaccuracy detection process**
As a substantial deviation of demand versus forecast is detected by the analytical department this is reported to the Material Manager or Director of Supply Chain and Manufacturing. They report it in addition to the responsible marketing product owner and start a conversation how to act on the deviation. The actions that are taken are described to be a result of ad hoc decisions. Moreover, there are for instance no standard procedures or documentations that state how to act in case of certain deviations of demand with respect to the forecast.

**Forecast inaccuracy difficulties of the iphone-cases**
The Iphone-4 cases were launched at 17 November 2012. The Business case of the iphone-4 cases forecasted a demand of 1350 products and 4106 products in respectively November and December 2012. Five days after the launch the forecasted demand of November was almost reached, and ten days after the launch the forecasted demand of November and December together was already reached. This illustrates that the actual demand of Iphone-cases was much more than initially anticipated. The substantial increase in demand resulted in two main difficulties for supply chain and manufacturing.

First, capacity problems. The initial production facility (and set-up) was not calculated to produce the requested demand. In addition, there were initially not enough employees skilled to produce iphone-cases. To solve this difficulty, additional employees were trained to be able to produce iphone-cases.
Second, material problems. Because of the immense demand there needed to be ordered more raw material (i.e. non-manufactured material). However, due to the long normal delivery time by sea transport, raw materials needed to be faster shipped. This was mainly done by air transport with as a consequence higher transport costs of around 32,000 euro.

1.1.2. Forecast process analysis
The forecast process is mainly derived from internal documentation but is verified by interviewing employees to validate if the documentation reflects the actual situation.

Forecasting process
Monthly demand forecasts are produced on a quarterly basis. But more regular updates are possible. The demand forecast is used by marketing, finance, and manufacturing. The forecast is seen as a goal and includes a certain year over year growth rate in order to maintain a desired year over year growth for the entire company. During the quarter, all organizational functions are assumed to actively manage towards the goal. A process flow model of the forecasting process is shown in Appendix A. I explain the process elements accordingly.

Forecast Setup
The forecast setup includes some basic steps, such as the product (group) to be forecasted, the time period of the forecast. New products can be added in the setup step as well.

Data Preparation
After the setup the data preparation can start. This starts with the actual data acquisition, i.e. retrieving historical demand information of the product groups specified in the setup. Next to this, the retrieved data is exported to SAS, a commercial statistics package, to facilitate statistical forecasting. At this point the data is considered ‘analytics data’ or ‘baseline forecast’. Currently, for time series forecasting of product groups exponential models are used, explicitly addwinters and multiwinters models. For time series analysis 36 months of historical data is considered whereby recent data is heavier weighted. For products with seasonality a special method in SAS is used for the seasonality months, i.e. September to December, and only these months are considered in the data series. Notice that the forecasting method chosen and the accompanying variable selection, model specification, parameter estimation and data analysis require judgemental input. There needs to be made assumptions that can considerable effect the output. Sterman (2000) shows that the length of the historical time horizon used to estimate a model parameter dramatically affects the forecast.

Forecast Activity
The forecast activity starts with the dashboard file preparation. An Excel Dashboard document is prepared for product managers. Product managers can adjust the analytics data and submit their changes to the database through the dashboard. Adjustments from the product team are mainly needed for new products or for products where recent trends,
such as changing demand due to marketing campaigns or cannibalization of new products, can cause projections to deviate from historical performance. Generally the baseline forecast is sufficient for larger volume, established products with longer history and no adjustment by product marketers are necessary. The product marketing team also provides rationale for any changes that they are making to the baseline forecast. During the review meeting, products that have significantly changed from the previous forecast are emphasized and updates are eventually made. In addition, there can be applied an adjustment (‘stretch’) factor to certain products to reflect the impact of channel forecasting. A channel describes a particular method or technique for acquiring and retaining customers. Currently, for the EU market there are more than 60 employees involved in the quarterly forecast spending in total approximately more than 600 hours.

The main problem of the judgemental forecast activities is that it result in islands of forecasting and undesirable data modification that impedes organizational learning and consensus within the organization. Organizational learning is defined as the process in which knowledge and capabilities are developed (Van Aken et al., 2007). Organizational learning can be established when there is an understanding why forecast errors occur and how to avoid them accordingly. For instance, imagine that the statistical forecast is positively adjusted because there is an upcoming marketing promotion that is believed to positive effect demand. If the final adjusted forecast turns out to be too positive a reasonable explanation could be that, ceteris paribus, the promotion was not as effective as expected.

**Manufacturing split**

Next to the forecast activity the manufacturing split is conducted. This entails the translation of product group forecasts in manufacturing entities such as production type. This translation is not forecast specific. To illustrate, the same physical manufacturing product may be sold as different marketing products. Furthermore, the manufacturing split is adjusted. This includes possible adjustments to the manufacturing split proportions. To assure that manufacturing proportions are composed out of integers.

**Reporting**

Currently, two reports are provided. Respectively, the live report and the tracking report. The live report tracks product manager submissions and provides insight into forecasting progress. The tracking report tracks the forecast accuracy in bookings by comparing forecasted data with actuals from Griffin, the primary database of Vistaprint.

**Conclusion**

Quantitative or statistical forecasting is of high importance within the forecasting process. But judgemental adjustments play an important role as well. The forecast process analysis shows that the statistical forecast can be judgementally adjusted by product marketing and in addition by channel marketing. These separate adjustments result in islands of forecasting and undesirable data modification. It is therefore hard to reason why forecast errors occur and how to avoid them accordingly (i.e. facilitate organizational learning).
1.2 Research question

Vistaprint is not satisfied with the current forecast process and feels that there is ample opportunity to improve the forecast accuracy. Furthermore, volumes are under pressure and marketing strategies are changing whereas minimizing forecast errors becomes even more important to avoid costs and satisfy customer needs. The preliminary information revealed due to interviews with stakeholders, internal documentation, analysis of the introduction of the iphone-cases, and forecast process analysis make clear that there are several issues. I discuss these issues accordingly.

First, the solving process of forecast inaccuracies is inappropriate. How is dealt with forecast inaccuracies is currently an ad hoc process for which no guiding framework is present. If a substantial forecast inaccuracy is detected by the analytical department this is reported to the Material Manager or Director of Supply Chain and Manufacturing. They report it in addition to the responsible marketing product owner and start a conversation how to act on the deviation. The actions that are eventually taken are described to be a result of experience based ad hoc decisions. Furthermore, if there are issues regarding the forecast they are most often escalated to the management team. Such a way of working makes the decisions that are taken very dependent on certain employees, i.e. the material manager and or supply chain and manufacturing director and the responsible marketing product owner. In short, there are no standard procedures or documentations that state how to act in case of certain deviations of demand with respect to the forecast.

Second, organizational functions operate in silos. The tasks and objectives of the organizational functions that are dependent on the forecast accuracy differ. Furthermore, differences in the power and the organization of the different functions and especially differences between marketing and manufacturing are ignored. Collection of reliable information or data is difficult and uniformity of information between different functional areas is hindered by the differences in the way functional areas are organized. As a result employees start to mistrust and second-guess each other. There exist prejudices among manufacturing and supply chain employees and marketers. For instance, remarks such as marketing is the problem and marketing does not know what they are doing or how they affect us (supply chain) are common prejudices. Overall, employees are too focused on their specific silo and no longer understand how other functional areas work and how to reach common organization wide objectives (Vistaprint, 2013).

Third, the generation of the forecast and in specific how the forecast is generated may influence the forecast performance in terms of accuracy. The forecast process analysis shows that separate judgemental adjustments of the statistical forecast result in islands of forecasting and undesirable data modification that impedes organizational learning and consensus within the organization.

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3 The interviews and documentation are summarized in Appendix B.
From these findings a preliminary cause and effect diagram can be constructed which shows the main issues and their causes. The cause and effect diagram is shown in Figure 1.2. Notice that the causes and effects are not mutually exclusive. For instance, the observation that functions operate in silos also adds to the existence of islands of forecasting.

![Figure 1.2 Preliminary cause and effect diagram](image)

Based on this preliminary information a research question is formulated. I focus on the forecast generation process. In specific, the judgemental adjustment of the statistical forecast. Therefore, the research question is:

*How can Vistaprint optimize the use of statistical and judgemental forecasting to minimize the forecast error?*
The belief is that if the forecast accuracy can be improved by optimizing the use of statistical and judgemental forecasting this is also beneficial for the solving process of forecast inaccuracies and the organizational alignment.

The research objectives are to: (1) provide insight in the current forecast performance; (2) investigate which aspects of statistical and judgemental forecasting (most) influence the forecast accuracy; (3) provide insight how to optimize the use of statistical and judgemental forecasting to minimize the forecast error; (4) provide concrete recommendations how to optimize the use of statistical and judgemental forecasting to minimize the forecast error; and (5) contribute to the demand forecasting literature.

1.3 Project structure
The project structure is as follows. First, I provide theoretical background on the topic. Second, I define the hypotheses according to the theory and the research question. Third, I provide comprehensive analysis and interpretation of findings. Fourth, I discuss the results and draw conclusions.
2. Theoretical background

2.1 The importance of forecasting

Why is forecasting so important? For many decisions a demand forecast is needed. Investment decisions, workforce planning, material purchasing and production decisions are often taken on basis of a forecast. The purpose of a forecast is therefore to effective support decision making. Aertsen, Theeuwen, and van Geel (2008) state that organizations need to forecast future demand to take action in advance to positive influence the future. Poor forecasting can result in unnecessary costs and poor customer service (Kremer, Moritz, and Siemsen, 2011).

2.2 Research directions forecasting literature

In scientific literature there is for several decades a debate going on over the value of judgemental and statistical forecasting methods (cf. Bunn and Wright, 1991; Lawrence, Goodwin, O’Conner, and Önkal, 2006). There is an ongoing belief among researchers that statistical methods should be preferred over judgemental methods (e.g. Bunn and Wright, 1991). Notice that although there is a distinction between statistical and judgmental methods, statistical methods always need judgemental input. There needs to be chosen an appropriate statistical method for instance. Nevertheless, I define judgement as judgemental adjustment to statistical models.

The preference of statistical methods over judgemental methods is the result of a strong belief that human judgement is fallible. This is mainly the result of psychological research that describe that people have difficulties accurately predicting future outcomes (e.g. Tversky and Kahneman, 1974) because they have limited cognitive abilities such as limited attention span, limited processing ability, and short-term memory (Sanders and Ritzman, 2004).

Furthermore, judgement is characterised as being associated with systematic biases and large errors, tendency to see patterns where non exist, illusion of control even when the underlying process is purely random, and excessive and unfounded confidence in its correctness (Lawrence et al., 2006; Harvey, 1995; O’Conner, Remus, and Griggs, 1993).

This strong belief has result in an immense area of research that tries to optimize statistical forecasting methods. However, today the importance of judgemental input is recognised more and more (Lawrence et al., 2006). Sanders and Ritzman (2004) conclude that recommendations made by previous studies to use solely statistical methods due to their overall highest accuracy do not consider human and organizational factors. While human behavior issues within organizational settings make the use of objective methods unrealistic. And in practice, judgement has always played an important role in forecasting (Lawrence et al., 2006) because judgement is privy to the latest information on changes in markets, competition, and the environment (Sanders and Ritzman, 2004). Blattberg and Hoch (1990) have shown that judgement and statistical methods have complementary
strengths and that therefore integrating statistical and judgemental methods can exploit strengths and compensate for weaknesses.

Similar, Sanders and Ritzman (2004) suggest that an ideal forecasting methodology is one that incorporates the advantages of both judgmental and quantitative approaches. In Table 2.1 is an overview given of advantages and disadvantages of both judgmental and quantitative approaches. However, research that empirically investigates the advantage of combining judgemental and quantitative forecasting is lacking (Webby and O’Conner, 1996; Sanders and Ritzman, 2004). Webby and O’Conner (1996) conclude that more research is needed to determine the role of contextual information, i.e. information other than the time series, which helps in the explanation, interpretation and anticipation of time series behavior.

However, the main question in literature remains how to combine statistical methods and judgemental input most effectively. Moreover, how statistical methods and judgemental input can be combined to forecast most accurate (in practice) remains unclear. This results in basically two research gaps

1. the extent to which judgement should be used, and
2. how and when quantitative forecasting methods should be combined with judgement.

Before I elaborate more on forecasting methodologies I introduce a forecasting framework that combines judgemental and statistical forecasting as proposed by Silver et al. (1998), explain which forecasting error situations mainly can occur and how they effect organizational performance. Next, I show how the acceptable costs of a forecasting system can be calculated and what influences the performance of demand forecasting.

Table 2.1 Overview of advantages and disadvantages (source: Literature review)

<table>
<thead>
<tr>
<th>Judgmental approach</th>
<th>Quantitative approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td><strong>Disadvantages</strong></td>
</tr>
<tr>
<td>Privy to latest information</td>
<td>Difficult to describe</td>
</tr>
<tr>
<td>High sense of ownership</td>
<td>Fallibility of human judgement</td>
</tr>
<tr>
<td>Can take special events into account</td>
<td>Expert (tacit/domain) knowledge required</td>
</tr>
<tr>
<td>No historical data required</td>
<td>Influenced by organizational politics</td>
</tr>
</tbody>
</table>
2.3 Forecasting Framework

Forecasting (or predicting) can be based on a combination of an extrapolation of what has been observed in the past (i.e. quantified estimation) and informed judgements about future events (i.e. qualified estimation) (Silver et al., 1998). Informed judgements can include marketing judgements such as the effects of promotions or reactions of competitors. I propose a forecasting framework that combines quantified and qualified estimation as shown in Figure 2.1.

![Figure 2.1 Forecasting Framework (source: Silver et al., 1998)](image)

In most organizations, the judgemental input plays an important role (Goodwin, 2001; McCarthy, Davis, Golicic, and Mentzer, 2006). Furthermore, as the actual demand in a period is observed, it is compared with the earlier forecast to measure the error in the forecast. It is important to monitor errors for at least three reasons (Silver et al., 1998). First, the quantity of safety stock needed to provide adequate customer service depends on the sizes of the forecast errors. Second, the statistical forecast is based on an assumed underlying mathematical model with specific values for its parameters. The sizes and directions of the forecast error could suggest possible changes in the values of the parameters of the model or even in the model itself. Third, the errors can provide a monitor and feedback on the judgemental input component of the forecasts. In conclusion, the forecasting framework provides input for both judgemental and statistical techniques. Silver et al. (1998) state that for important demand management decisions, human involvement in, and the ultimate responsibility for, forecasts is essential. For effective human involvement the performance insight of both statistical forecast and judgemental input is necessary. Nevertheless, McCarthy et al. (2006) conclude in their longitudinal study of forecasting practices that unless an increasing effectiveness and efficiency of statistical methods the most fundamental fact of demand forecasting is not considered; the
understanding of statistical and judgemental methods in their specific organizational context. Only if one understands the errors of the statistical forecast and the human input, the questions to which extent judgement should be used, and how and when judgement should be combined with quantitative forecasting methods to minimize the forecast error can be answered. Fildes et al. (2009) conclude that employees involved in forecasting are often not knowledgeable in the statistical limitations of forecasting and the fallibility of human judgement.

2.4 Forecast error situations and there consequences
Mainly, two forecast error situations can occur: overforecasting and underforecasting. In Figure 2.2 is an overview given of the overforecasting and underforecasting implications. I discuss them accordingly. If demand is underforecasted this can result in increased shipping costs and higher product cost due to shorter order lead time to suppliers if the company decides to satisfy underforecasted demand. If demand cannot be satisfied it can cause a potential loss in profit resulting from loss in sales and reduction of customer satisfaction (Kahn, 2002). Overforecasting can result in excess inventory costs, increasing holding costs, transshipment costs, obsolescence costs, reduced margin if products must be sold at a discount in order to liquidate inventory, and holding up working capital in excessive inventory (Kahn, 2002). In short, inaccurate forecasting can result in significant performance consequences.

![Figure 2.2](image)

*Figure 2.2 Two forecast error situations and their consequences (source: Kahn, 2002)*
2.4.1 Bias
In demand forecasting literature is often referred to bias as a forecast error situation. I use bias to indicate that, on average, the forecasts are substantially above or below the actual demand. Therefore, positive bias indicates that, on average, the forecasts are substantially above the actual demand. And, negative bias indicates that, on average, the forecasts are substantially below the actual demand.

Bias might signal that the parameters of the underlying demand model are inaccurately estimated or that the model itself is incorrect (Silver et al, 1998). Furthermore, forecasters may tend to either overforecast or underforecast depending on how the forecast error is measured or how they are rewarded. If underforecasting is punished more heavily than overforecasting forecasters might tend to overforecast and vice versa.

2.5 Forecast approaches
In literature are defined four approaches which may facilitate the integration of judgement with statistical forecasting methods. In Figure 2.3 is an diagrammatic overview of four approaches shown. Notice that the approaches are not mutually exclusive. For every statistical forecast is judgemental input needed (e.g. selection of variables and model specification). Unlike past research compared (statistical) methods on accuracy, I consider factors of human behavior, such as ownership and bias, and organizational factors, such as politics, that should indicate which method or combination of methods are most appropriate within the organizational context of Vistaprint.
Figure 2.3 Approaches for integrating judgemental and statistical forecasts (based on: Sanders and Ritzman, 2004; Webby and O’Conner, 1996)
2.5.1 Model building
Solely generating a statistical forecast may require no judgemental input. However, the selection and development of a quantitative forecast model requires a human judge. And, variable selection, model specification, parameter estimation and data analysis require judgemental input. Unless the substantial judgemental input that is needed to facilitate the statistical forecast this method is considered as least subjective to the negative effects of judgmental adjustment (Sanders and Ritzman, 2004).

2.5.2 Combining judgemental and statistical forecasts
The combination of a judgemental forecast with a statistical forecast is an approach to introduce contextual factors. There is concluded that combining two or more independent forecasts leads to significant improvements in accuracy (Silver et al., 1998; Clemen, 1989). I focus on the combination of objective and subjective forecasts. Sanders and Ritzman (2004) conclude in their literature review that the combination of judgmental and quantitative forecasts is preferred over judgemental adjustment because the latter is more subject to judgment’s negative effects. The simplest approach of combining judgemental and quantitative forecasts is using an equal weighted arithmetic average of the individual methods. Using more elaborating weighting schemes (i.e. weighted averages or regression based weighting schemes) could be beneficial but its complexity and time requirements make it less desirable in an organizational context.

2.5.3 Judgemental adjustment of statistical forecasts
This integration method uses judgement to adjust a quantitatively generated forecast based on contextual factors (Turner, 1990; Sanders and Ritzman, 2004). This forecasting method first generates a quantitative forecast and then adjust this forecast based on judgment. Sanders and Ritzman (2004) state that an advantage of this method is time, allowing human the ability to rapidly incorporate the latest information. Many research supports judgemental adjustment when contextual information is available (cf. Sanders and Ritzman, 2001; Goodwin and Fildes, 1999). This method is mainly used by Vistaprint as shown in the forecast process analysis.

2.5.4 Statistical correction of judgemental forecast
This methodology relies on judgement for forecast generation and reduces judgment’s error by performing a quantitative correction for bias directly on to the judgemental forecast (Sanders and Ritzman, 2004). Thiel (1971) developed a method for quantitative correction. I discuss this method roughly. Theil (1971) showed that bias can be removed from past forecast by regressing the actuals onto the forecast. Mathematically represented as:

\[
\text{Forecast error} = (A-F)^2 + (S_F - rS_A)^2 + (1-r^2)S_A^2
\]

where A and F are the means of the actuals and forecast respectively. S_F and S_A are the standard deviations of the forecast and actuals, and r is the correlation coefficient between the actuals and forecast. The first term of the equation is the mean bias, representing the
tendency of the model to continuously overforecast or underforecast. The second term of the equation is regression bias, representing a consistent deficiency of the forecast to track the pattern in the actuals. The last term represents the random error, i.e. unexplained variation in the actuals. When the actuals are regressed on the forecasts the form becomes:

\[ \hat{A}_t = a + bF_t \]

\( \hat{A}_t \) represents the estimated actual at time \( t \) and \( F_t \) represents the forecast at time \( t \). If \( \hat{A}_t \) is used as the corrected forecast; both mean and regression biases are removed from judgmental forecast. The correction can then remove systematic bias from future forecasts. Assuming that past biases continue in the future. Consequently, when the bias changes over time the correction becomes useless. This could for instance be to changes in the environment or market. Sanders and Ritzman (2004) state that this method is best suitable in situations where quantitative information is not available or in environments where the corrected judgment can be combined with quantitative forecasts.

2.5.5 Strengths and weaknesses of approaches

Table 2.2 gives the main advantages and disadvantages of the integration approaches and when best to use a particular approach. I discuss them accordingly. Once again, notice that the approaches are not mutually exclusive and therefore its characteristics as well.

The model building method is seen as the most objective integration approach. It is proven that this method is highly effective for forecasting, although it may not be able to incorporate contextual information in a timely matter (Sanders and Ritzman, 2004). The disadvantage of the method is that it requires knowledge and understanding of statistical forecasting techniques and its variables. Consequently, the employees that produce the statistical forecast should ensure that the users of the forecast understand how the forecast is produced so that the users can stand behind the forecast or criticize the forecast technique and or there variables explicitly. Because there is no possibility of adjusting the statistical forecast, the sense of ownership is low.

The method that combines statistical and judgemental forecasts has the advantage that it objectively combines the two. The method serves to diminish the negative effects of both forecasts, such as bias and model errors. Most desirable, the errors of both forecasts are negatively correlated and cancel each other out. For the same reason as the model building method the sense of ownership may be low.

The method that judgemental adjusts the statistical forecast can quickly incorporate the latest contextual information. Sanders and Ritzman (2004) suggest that this method has a high potential of biasing the forecast. Therefore, the judgemental adjustment needs to be made on high reliable information. Nevertheless, the judgemental adjustment provides a high sense of ownership because the statistical forecast can be adjusted.
The method of statistical correcting the judgemental forecast may eliminate the judgemental bias. However, the judgemental forecast can be modified over time, which can make correction unnecessary. Furthermore, the credibility of the judgemental forecast can be diminished with a low sense of ownership as result.

Table 2.2 Overview of advantages, disadvantages, and usefulness of integration approaches (source: Sanders and Ritzman, 2004).

<table>
<thead>
<tr>
<th>Integration approach</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>When to use?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model building</strong></td>
<td>Most objective method of forecast generation</td>
<td>Low sense of ownership</td>
<td>Users have adequate knowledge and understanding of forecast techniques</td>
</tr>
<tr>
<td><strong>Combining Judgmental and Statistical Forecast</strong></td>
<td>Objective combination</td>
<td>Low sense of ownership</td>
<td>If statistical and judgemental forecast are not correlated</td>
</tr>
<tr>
<td><strong>Judgmental adjustments of Statistical Forecast</strong></td>
<td>High sense of ownership</td>
<td>High potential for bias</td>
<td>High reliability of contextual information</td>
</tr>
<tr>
<td></td>
<td>Timely incorporation of contextual information possible</td>
<td>Subjective combination</td>
<td></td>
</tr>
<tr>
<td><strong>Statistical Correcting the Judgmental Forecast</strong></td>
<td>Effective at controlling bias</td>
<td>Low sense of ownership</td>
<td>High chance on judgemental bias</td>
</tr>
</tbody>
</table>

2.5.6 Conclusion
Vistaprint uses the integration approach that makes use of judgmental adjustment of statistical forecast. The potential disadvantages are that there is a high potential for bias, the contextual information must be of high reliability, and that organizational politics can influence the forecast. These disadvantages should be thoroughly investigated to understand if they effect the forecast performance and how to overcome these disadvantages eventually by optimizing the use of statistical and judgemental forecasting.

2.6 What forecast integration approach to use?
The forecast procedure that keeps the expected total relevant costs up to some future decision horizon as low as possible will rationally be chosen. The costs can be defined as the costs to obtain a forecast and the costs that result from the forecasting errors made. How to calculate those costs?
Kahn (2003) developed a method that measures the rough impact of a forecast error on an enterprise according to the two forecasts error situations as shown in Figure 2.2. The basic implication of underforecasting is the potential loss of profit resulting from an increase in cost and loss in sale and the basic implication of overforecasting is tying up of financial resources in excessive inventory. The formulas for measuring an underforecast and overforecast for a certain time period are as follows:

Lost Profit Cost = 1% X SKU Volume x Profit Margin Per Unit;

Inventory Cost = 1% x SKU Volume x (Product Unit Cost + Inventory Holding Costs Per Unit).

The outcome of the formulas represents a potential cost range for 1% forecast error. Multiplying this number by the respective organization’s actual forecast error gives the potential cost of forecast error. Nevertheless, the intent of using these calculations is to provide a range of possible forecast error cost to indicate its financial impact and verify the need for improvement of forecasting.

In addition, the cost of operating a forecasting system is hard to measure. However, the costs should mainly exist out of labor cost and forecast procedure cost (i.e. software package).

The acceptable costs for operating a forecasting system should be based on two issues (Silver et al., 1998). Namely, importance of a product and time-period of decision. The relative importance of a product to the company in terms of revenue generation and strategic importance can desire a more accurate forecast and therefore higher forecast operating costs are acceptable. The expected costs of errors in short-range, individual product forecasts are likely to be much smaller than those associated with longer-term forecasts made for aggregate inventory management and production planning decisions (Silver et al., 1998).

2.7 What influences demand forecasting?

In literature is a debate going on over the value of judgmental and statistical forecasting methods. Recently, the integration of judgmental and statistical forecasting methods is proposed as the best solution to minimize forecast error (cf. Sanders and Ritzman, 2004; Caniato, Kalchschmidt, and Ronchi, 2011). In literature are mentioned several causes that can influence the performance of integrating judgmental and statistical forecasting methods. These causes should help to provide answers to the research gaps; the extent to which judgment should be used, and how and when quantitative forecasting methods should be combined with judgment. In addition, these answers could help Vistaprint to optimize the use of statistical and judgemental forecasting to minimize the forecast error. I discuss the causes accordingly.
2.7.2 Size of judgemental adjustment
Mathews and Diamantopoulos (1990) conclude that forecast accuracy improvement is more when there are performed larger judgemental adjustments. Fildes et al. (2009) argues why larger adjustments may be more effective. Large adjustments are likely to be associated with reliable information about events which will have large anticipated effects not reflected in the statistical forecast. In contrast, smaller adjustments are likely to be less effective because if the information on which the adjustment is based is viewed as unreliable, the forecaster is likely to provide a small adjustment. Fildes et al. (2009) conclude according to human decision making research that forecasters make small adjustments to a provided forecast which have no sound basis and therefore diminish its accuracy. Furthermore, there is suggested that forecasters often modify statistical forecasts to show that they have reviewed the (statistical) forecast and are attending to their task (Lim and O’Conner, 1995).

2.7.3 Volatility
Another factor that could influence the need of judgemental input is volatility of the demand time series. Sanders and Ritzman (1992) conclude that when series have low volatility, as measured by the coefficient of variation, statistical forecasting methods outperform judgemental forecasts. In contrast, by high volatility judgemental forecasts outperform statistical forecasts. This suggests that higher levels of volatility are the result of the effects of special events, of which the judgemental forecaster had some prior knowledge. However, when the volatility reflects random fluctuations judgemental forecast performs worse than statistical forecast as volatility increases, because the forecaster tends to overreact to noise (Fildes et al., 2009).

3. Hypotheses
According to the theoretical review, interaction of judgemental and statistical methods can help to minimize the forecast error. For Vistaprint in specific, as outlined in the forecast process analysis, there is generated a statistical forecast and this forecast is judgementally adjusted in sequence. The judgemental adjustment involves considerable effort and time. But the question remains if they improve accuracy, and when they are most effective. To test for the importance of judgemental adjustment I formulate hypotheses. These hypotheses should accordingly provide means to optimize the use of statistical and judgemental forecasting to minimize the forecast error.

Research shows that forecasters are able to correctly adjust the statistical forecast that otherwise should be less accurate (Diamantopoulos and Mathews, 1990; Fildes et al., 2009). This is an important finding because if forecasters are not able to revise the poorest statistical forecasts the benefits of judgemental input diminish. Diamantopoulos and Mathews (1990) state that any failure to select the statistical forecast that needs revision
most indicates a possible deficiency in the information base which are used for judgemental adjustment. Therefore, I hypothesize

**H1.** The statistical forecasts selected for adjustment are those most in need of improvement.

Experimental as well as empirical research conclude that when an adjustment is made on the basis of events not reflected in the statistical forecast it is likely to improve the accuracy of the statistical forecast, assuming that the event information (and its effect) is reliable (Fildes et al., 2009; Goodwin and Fildes, 1999; Lim and O’Conner, 1996). For instance, if a promotion is planned that should generate additional demand and this effect is judgementally added to the statistical forecast it should improve the accuracy of the statistical forecast. However, if the promotion effect is not reliable it could decrease the statistical forecast accuracy. As such, the effect of the promotion can be validated and stimulate organizational learning.

Furthermore, organizations in general and Vistaprint in particular employ substantial resources (i.e. approximately 600 employee hours per quarter) in the forecast adjustment activity. According to economic rationality spending substantial resources implicates that it should be valuable. Moreover, organizational resources (e.g. employees) are scarce and spending substantial resources in the forecast adjustment activity should add value to the forecasting performance (i.e. improve statistical forecast accuracy). Therefore,

**H2.** Judgemental adjustments of statistical forecasts improve forecast accuracy.

In addition, Syntetos, Nikolopoulos, Boylan, Fildes, and Goodwin (2009) conclude in their empirical research that negative judgemental adjustments of statistical forecasts perform better than positive adjustments of statistical forecasts in terms of improving forecast accuracy. They suggest that the relative poor performance of positive adjustments may be a result of an optimism bias (i.e. tendency to overforecast) on the part of the forecasters. Optimism bias can lead to positive adjustments without a reliable underpinning that the forecast needs to be positive adjusted or an excessive upward adjustment as a result of some reliable evidence. Probably indicating that the effect size of the evidence is too optimistic. Furthermore, unnecessary or excessive upward adjustment can be motivated by political factors such as pressure from senior management or rewarding systems. Within Vistaprint the forecast is seen as a target and a certain year over year growth rate is included in the forecast. This may result in a tendency to positive adjust the statistical forecast without reliable evidence. In contrast, negative adjustments are more likely based on reliable evidence and applied correctly because they might be not or less concerned with political factors. Although, a negative judgemental adjustment could be concerned with (political) factors that undermine its performance previous research did not find this tendency. Therefore, I hypothesize that
H3. Negative judgemental adjustments of statistical forecasts improve forecast accuracy more than positive judgemental adjustments of statistical forecasts.

The investigation of Diamantopoulos and Mathews (1989), Fildes et al. (2009), and Syntetos et al. (2009) show that relatively larger adjustments, i.e. adjustments larger than 10% to the statistical forecast, tended to lead to greater average improvements in accuracy. In contrast, small adjustments, i.e. adjustments smaller than 10% to the statistical forecast, tended to decrease accuracy. As already argued in the theoretical background large adjustments are likely to be associated with reliable information about events which will have large anticipated effects not reflected in the statistical forecast. In contrast, smaller adjustments are likely to be less effective because if the information on which the adjustment is based is viewed as unreliable, the forecaster is likely to provide a small adjustment. Fildes et al. (2009) conclude according to human decision making research that forecasters make small adjustments to a provided forecast which have no sound basis and therefore diminish its accuracy, and that forecasters often modify statistical forecast without a concrete reason but to show that they have reviewed the (statistical) forecasts and are attending to their task. Furthermore, Goodwin (2001) suggests that decision makers are more likely to accept forecasts if they have a high sense of ownership of the forecasts, because they have contributed to the process that derived the forecast. This could also be a reason that forecasters make small adjustments to a given statistical forecast which have no sound basis and therefore diminish its accuracy. Therefore, I hypothesize that

H4. The sizes of the judgemental adjustments are positively associated with an improvement in accuracy (i.e. larger adjustments to the statistical forecast (>10%) improve forecast accuracy more than smaller (<10%) adjustments).

Sanders and Ritzman (1992) conclude that when time series are stable and regular (i.e. low data variability), statistical time series methods outperform judgemental forecasts. Statistical methods have difficulty achieving reasonable forecasts when the data are more variable. While judgemental forecasts reinforced by contextual information perform better then. This suggests that higher variability is the result of effects of factors that are not captured in the statistical model but of which the judgemental forecaster has some prior knowledge. When the variability solely reflects noise there is evidence that judgemental input negatively effects statistical forecasts (O'conner et al., 1993). This is because human tend to overreact to noise (Goodwin and Fildes, 1999, Fildes et al., 2009).

In addition, Sanders and Ritzman (1992) suggest in their research that the data variability is an explanation for the debate about the value of judgemental and statistical forecasting methods. Higher variability of statistical forecast can reflect the need of judgemental adjustment. Moreover, it can be an explanation why some research recommends using judgemental methods and other research recommends using statistical methods.
Vistaprint is a highly marketing driven organization. Sales promotions are frequently conducted. The (marketing) employees involved in the forecast have advance information about sales promotions. Sales promotions are not part of the statistic method but are intertwined in the dataset that is used for statistical forecasting. I hypothesize that

H5. Judgemental forecast adjustment improves the forecast accuracy more under high volatile than low volatile conditions.

Bias is decomposed in mean bias and regression bias (Fildes et al., 2009). Mean bias is defined as a systematic tendency for the forecast to be either less or greater than the actual. Regression bias is defined as the extent to which the forecast systematically fail to track the actual demand. I defined bias as the tendency to either continuously under- or overforecast therefore I consider mean bias. In the forecast process analysis I state that the forecast is seen as a target to reach a certain year over year growth rate. Lawrence, O’conner, and Edmundson (2000) state that if forecasts are used as targets to encourage superior performance it is likely that there is a systematic positive bias in the forecast.

If employees are rewarded for exceeding the sales target, there may be a tendency to underforecast. Because there may be pressure for the forecasts to be less than the actual (Lawrence et al., 2000). Resulting in a negative bias accordingly.

In addition, if company policy prescribes that there may be no lost sales, there may be a tendency to overforecast; introducing positive bias. Furthermore, differences in overstocking costs and understocking costs may lead to forecast bias (Fildes et al., 2009). If there is a belief that underforecasting is more costly than overforecasting this can result in a tendency to overforecast and therefore initiate a positive forecast bias. For Vistaprint there seems to be a tendency to overforecast and introduce positive bias because the forecast is seen as a target and organizational policies prescribe not to run out of stock. Therefore, I hypothesize

H6. The judgementally adjusted forecasts introduce positive bias.

Fildes et al. (2009) show that negative adjustments reduce the mean bias in statistical forecasts, and conclude that negative adjustments are realistic. Contrary, they show that positive adjustments increase mean bias and conclude that positive adjustments are often too optimistic (i.e. positively biased). Therefore, I assume that negatively judgmentally adjusted forecasts are not biased and positively judgmentally adjusted forecasts are positively biased. I hypothesize accordingly

H6a. The negatively judgementally adjusted forecasts are not biased.

H6b. The positively judgementally adjusted forecasts are positively biased.
4. Methodology

4.1 Research context and scope
My research is conducted at Vistaprint, the leading online provider of marketing products and services to small businesses around the globe. In appendix C is a detailed company overview given. The business unit, time horizon, and product groups that form the sample are discussed in sequence.

4.1.1 Business unit
Vistaprint exist out of two main business units that each entail two markets based on their geographic location. The first unit is the traditional business unit. This unit is divided in the North America and European Market. I concentrate on the European market because may research is conducted at the European production plant and the European market differs slightly from the North America market which makes the combination of this data not desirable.

4.1.2 Time horizon
Vistaprint conducts product group forecasts on a quarterly basis. I have chosen a time horizon of three (financial) years to overcome the seasonal effect; Vistaprint has a significant increase in demand in the last three months of a calendar year. Resulting in 12 quarterly forecasts. The most recent ended forecasts with known actuals are chosen. This results in the forecast of July 2010 till March 2013.

4.1.3 Product Groups
Vistaprint offers almost 100 customizable products that result in a forecast for around 340 manufactured products. However, the forecast is initially conducted for product groups (i.e. aggregation of individual products). There are distinguished 24 product groups. The forecast of product groups are considered in this research because if the forecast on the product group level is not conducted correctly it is not likely that the forecast of an individual product is correct. Wallace (2004) states that the best performing companies forecast their product groups first and extensively and later on as a consequence have less difficulty with forecasting their individual products. Furthermore, Silver et al. (1998) state in their guidelines for the input and monitoring of judgement that the starting point should be the aggregated (statistical) forecast. Moreover, the start point needs to be correct.

The selection of product groups is based on the following criteria:

- The product group is forecasted for the historical time horizon chosen.
- The product group is of high importance in terms of demand and/or revenue.

The product group is of high importance when the average monthly demand is higher than 10.000 units and/or the average revenue is higher than 100.000 euro per month for the chosen time horizon. An overview of the chosen product groups and their main characteristics and selection criteria are shown in Table 4.1.
<table>
<thead>
<tr>
<th>Product Group</th>
<th>Characteristics</th>
<th>Average demand* (units/month)</th>
<th>Average Revenue* (EUR/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Cards</td>
<td>Vistaprint’s most important product group in terms of revenue</td>
<td>159.543.735</td>
<td>6.478.526</td>
</tr>
<tr>
<td>Banners</td>
<td>There can be distinguished for different banners; focused on business and signage market</td>
<td>37.812</td>
<td>670.711</td>
</tr>
<tr>
<td>Cardoor Magnets</td>
<td>Stable demand pattern</td>
<td>52.502</td>
<td>420.786</td>
</tr>
<tr>
<td>Envelopes</td>
<td>Seasonality at end of calendar year; typical supplementary product</td>
<td>743.814</td>
<td>245.602</td>
</tr>
<tr>
<td>Flipbooks</td>
<td>Relative small product group in terms of demand; Seasonality at end of calendar year</td>
<td>14.633</td>
<td>109.322</td>
</tr>
<tr>
<td>Flyers</td>
<td>High aggregation level and high important product group in terms of revenue</td>
<td>7.910.152</td>
<td>1.372.568</td>
</tr>
<tr>
<td>Invitation and Announcements</td>
<td>High aggregation level and high important product group in terms of revenue</td>
<td>1.294.467</td>
<td>1.339.401</td>
</tr>
<tr>
<td>Lawn Signs</td>
<td>Relative small product group in terms of demand</td>
<td>21.101</td>
<td>207.884</td>
</tr>
<tr>
<td>Notebooks</td>
<td>Relative small product group in terms of demand</td>
<td>22.966</td>
<td>119.491</td>
</tr>
<tr>
<td>Notepads</td>
<td>Relative small product group in terms of demand</td>
<td>21.283</td>
<td>104.073</td>
</tr>
<tr>
<td>Photobooks</td>
<td>Products are currently made solely at Album printer; seasonality at end of calendar year</td>
<td>9.403</td>
<td>101.045</td>
</tr>
<tr>
<td>Postcards</td>
<td>Important product group; seasonality at end of year</td>
<td>11.683.987</td>
<td>1.602.304</td>
</tr>
<tr>
<td>Wall Calendars</td>
<td>High important product group; seasonality at end of year</td>
<td>286.198</td>
<td>2.206.616</td>
</tr>
</tbody>
</table>

*Based on chosen time horizon
4.2 Method selection
In this project was used secondary data to test the hypotheses. I clarify why this type of data is used accordingly. Notice that primary data, i.e. exploratory interviews (appendix B), was used to identify improvement possibilities.

4.2.1 Secondary data
Secondary data was used in the form of documentation. Within Vistaprint a widespread of product data is collected and stored in databases. Next to that, Vistaprint’s knowledge such as project information is documented in an online encyclopedia called ‘Vistawiki’. An overview of the advantages and disadvantages of this type of data collection is given in Table 4.2. Secondary data was used in this project because it is the best data available to get historical and comprehensive information to test the hypotheses.

Table 4.2 Overview of advantages and challenges of secondary data

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get comprehensive and historical information</td>
<td>Often takes much time</td>
</tr>
<tr>
<td>Information already exists</td>
<td>Information may be incomplete</td>
</tr>
<tr>
<td>Few biases about information</td>
<td>Not flexible means to get data; data restricted to what already exists</td>
</tr>
</tbody>
</table>
4.3 Statistical models and Measurements

An overview of the conceptual models is shown in Figure 4.1.

I discuss the variables to test the hypotheses accordingly.

4.3.1 Forecast error

In this research the forecast error is measured using the following formula

\[
\frac{|a_i-f_i|}{a_i} \times 100\%
\]

\(a_i = \text{actual demand in period } i \text{ (month)}\)

\(f_i = \text{forecasted demand in period } i \text{ (month)}\)

This measurement represents the mean absolute percentage error (MAPE) and is often used in literature and practice (cf. Gartner and Thomas, 1993; Fildes and Goodwin, 2007).
Notice that the accuracy is interpreted as a number between zero percent and 100 percent. According to the assumption that a forecast is perfect or relative accurate or inaccurate or just plain incorrect. Furthermore, the measurement is not appropriate if demand values are very low because a forecast of two units of demand and an actual demand of one unit already results in an error of 100 percent. However, the products of Vistaprint are characterized by high volumes. Furthermore, the formula can introduce a bias in the performance measurement. Underforecasting can be encouraged because a higher actual reduces reported forecast error. This should be kept in mind by evaluating the results.

4.3.2 Forecast adjustment
Various measures have been proposed to measure forecast adjustment. I measure the forecast adjustment as (Fildes et al., 2009)

\[
\frac{|\text{Final Forecast} - \text{Statistical Forecast}|}{\text{Statistical Forecast}}
\]

4.3.2 Effect size of judgemental adjustments on accuracy
The effect size of judgemental adjustments on accuracy is measured as follows

\[
\frac{|\text{Actual Demand} - \text{Statistical Forecast}| - |\text{Actual Demand} - \text{Final Forecast}|}{\text{Actual Demand}}
\]

It represents the difference between the absolute percentage forecast error from the statistical forecast and the absolute percentage forecast error from the final and adjusted forecast. This variable is positive when the adjustment improves the statistical forecast and negative when the adjustment reduces the accuracy.

4.3.3 Volatility
Sanders and Ritzman (1992) measure variability based on the variation coefficient of the actual demand data. Fildes et al. (2009) measure variability based on the variation coefficient of the statistical forecast. This eliminates the variability which is capable of being statistical forecasted. In this research is the volatility measurement based on the statistical forecast group as well. Statistical forecasts that have a higher than average forecast error (MAPE) are marked as high volatile and those with a lower than average forecast error (MAPE) are marked as low volatile.

4.3.4 Bias
Bias of judgemental adjustment can be measured using the method of Theil (1971). Theil showed that the mean squared error (MSE) of a series of forecasts can be decomposed into three components. Namely,

\[
\text{MSE} = (A-F)^2 + (S_F - rS_A)^2 + (1 - r^2)S_A^2
\]

where A and F are the means of the actual and forecast respectively. \(S_F\) and \(S_A\) are the standard deviations of the forecasts and actuals, and \(r\) is the correlation coefficient between
the actuals and forecasts. The first term of the equation is the mean bias, representing the tendency of the model to overforecast or underforecast. The second term of the equation is regression bias, representing a consistent deficiency of the forecast to track the pattern in the actuals. The last term represents the random error, i.e. unexplained variation in the actuals. Theil showed that when the actuals are regressed on to the forecasts this can be used to remove the mean and regression bias from a series of past forecasts with known actuals. The form becomes:

\[ A_t = \hat{a} + \hat{b} F_t + i_t \]

\( A_t \) represents the (estimated) actual at time \( t \). \( F_t \) is the judgemental adjusted forecast for period \( t \), \( i_t \) is the residual at time \( t \), and \( \hat{a} \) and \( \hat{b} \) are the estimated regression coefficients. If the judgemental adjustment is unbiased \( \hat{a} \) should be zero and \( \hat{b} \) should be one. If there is a consistent pattern of underforecasting (i.e. negative bias) or overforecasting (positive bias), \( \hat{a} \) should be respectively positive or negative. Notice that the correction assumes that the bias remains constant.

Another method to examine bias is by analyzing the frequencies of occurrence of positive and negative signs in the forecast error (cf. Lawrence et al., 2000). If the forecasts are unbiased there should be, on average, an equal distribution of positive and negative errors. The binomial test can be used to determine if there is a significantly difference from the 50% probability which is expected if the forecast is unbiased.

### 4.4 Statistical analyses

To test the hypotheses t-tests and binomial tests are conducted. For the first two hypotheses dependent t-tests are used. There are two conditions and the same sample size is assigned to each condition. The independent means t-test is used for the third, fourth, and fifth hypotheses. There are two conditions and to each condition are different samples assigned. The sixth hypothesis and its two sub-hypotheses are binomial tested.

The rationale for the t-test is as follows (Field, 2005):

- Two samples of data are collected and the sample means calculated. These means may differ by either a little or a lot.
- There is assumed that the condition considered in the hypothesis has no effect on the outcome (i.e. null hypothesis). Therefore, the sample means are expected to be very similar.
- The difference between the sample means that are collected are compared with the difference between the sample means that is expected to obtain by chance. The standard error is used as a gauge of the variability between sample means. If the standard error is small, then is expected that most sample means have very similar means. If the standard error is large the differences in sample means is expected to be large by chance alone. If the difference between the sample sizes is larger than what is expected based on the standard error then can be assumed two things:
- Sample means fluctuate a lot by change alone.
- The difference between samples represents a genuine difference between the samples and therefore the null hypothesis is incorrect.

Assumptions of the t-test (Field, 2005):
- Data are from normally distributed populations.
- Data are measured at least at the interval level.

The independent t-test assumes in addition:
- Variances in these populations are roughly equal (homogeneity of variance).
- Measurements are independent.
5. Analysis and Interpretation of Findings

In Table 5.1 is the data set summarized. Data is collected from July 2010 till March 2012. The table shows the number of observations (N) that contain the statistical demand forecast, the final adjusted forecast, and the actual demand. The table shows also the percentage of statistical forecasts that are adjusted and the number of product groups included. This already indicates that the statistical forecast is almost always adjusted.

Table 5.1 Overview of data set

<table>
<thead>
<tr>
<th>Data range</th>
<th>Sample size (N)</th>
<th>% adjusted</th>
<th>No. of product groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/2010-03/2013</td>
<td>429</td>
<td>99.5</td>
<td>13</td>
</tr>
</tbody>
</table>

Figure 5.1 shows the size of the relative adjustments that are made to the statistical forecast. The distribution of the adjustments is positively or right skewed. Notice that the distribution would even be more skewed if the extremely high positive adjustments were included. There are some extremely high adjustment values excluded in the histogram because they would tremendous effect the analysis. The extremely high positive adjustments are shown separately in Table 5.2. The table shows the date of the adjustment, the percentage of relative adjustment, the product group, and the event. The event provides an explanation for the extreme adjustment. Extremely high adjustments are made to the photobooks because of the acquisition of Album printer (a photobook company) and therefore a substantial increase in photobook demand. The adjustments of flyers are due to a new aggregation level. Products that were previous part of postcards are aggregated to flyers. The events indicate that there was sufficient evidence that the outcome of the statistical forecast was no longer correct and judgemental adjustment was definitely needed.

![Figure 5.1 Size of the relative adjustments that are made to the statistical forecast](image-url)
Table 5.2 Overview of extremely high adjustments

<table>
<thead>
<tr>
<th>Date</th>
<th>Adjustment (%)</th>
<th>Product Group</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/2010</td>
<td>6902</td>
<td>Photobook</td>
<td>Outlier</td>
</tr>
<tr>
<td>02/2012</td>
<td>562</td>
<td>Photobook</td>
<td>Album printer</td>
</tr>
<tr>
<td>10/2012</td>
<td>189</td>
<td>Photobook</td>
<td>Album printer</td>
</tr>
<tr>
<td>11/2012</td>
<td>184</td>
<td>Photobook</td>
<td>Album printer</td>
</tr>
<tr>
<td>12/2012</td>
<td>260</td>
<td>Photobook</td>
<td>Album printer</td>
</tr>
<tr>
<td>01/2013</td>
<td>373</td>
<td>Photobook</td>
<td>Album printer</td>
</tr>
<tr>
<td>02/2012</td>
<td>796</td>
<td>Flyers</td>
<td>New aggregation</td>
</tr>
<tr>
<td>03/2012</td>
<td>2722</td>
<td>Flyers</td>
<td>New aggregation</td>
</tr>
<tr>
<td>04/2012</td>
<td>2280</td>
<td>Flyers</td>
<td>New aggregation</td>
</tr>
<tr>
<td>05/2012</td>
<td>2624</td>
<td>Flyers</td>
<td>New aggregation</td>
</tr>
<tr>
<td>06/2012</td>
<td>662</td>
<td>Flyers</td>
<td>New aggregation</td>
</tr>
<tr>
<td>07/2012</td>
<td>770</td>
<td>Flyers</td>
<td>New aggregation</td>
</tr>
<tr>
<td>08/2012</td>
<td>527</td>
<td>Flyers</td>
<td>New aggregation</td>
</tr>
</tbody>
</table>

Table 5.3 shows the mean, trimmed mean, and median of the relative adjustments for the positive and the negative adjustment separately. Whereby a positive adjustment indicates that the final forecast exceeds the statistical forecast. It can be seen that the positive adjustment are on average larger than the negative adjustments. The mean of the positive adjustment is due to the positive skewness relative large. Therefore, the trimmed mean and median are given to provide a more comprehensive view. The trimmed mean excludes the highest and lowest 5% of the adjustments.

Furthermore, Table 5.3 shows that the average forecast error (i.e. MAPE) of the adjusted statistical forecast is lower than the statistical MAPE for both negative and positive adjustments. This indicates that the adjusted forecast on average outperforms the statistical forecast.

Table 5.3 Overview of Mean, trimmed mean, and median of the relative adjustments and MAPE

<table>
<thead>
<tr>
<th>Direction of adjustment</th>
<th>N</th>
<th>Relative adjustment (%)</th>
<th>MAPE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>TrMean</td>
</tr>
<tr>
<td>Positive and Negative</td>
<td>427</td>
<td>57.2</td>
<td>12.1</td>
</tr>
<tr>
<td>Positive</td>
<td>191</td>
<td>115.2</td>
<td>22.1</td>
</tr>
<tr>
<td>Negative</td>
<td>236</td>
<td>10.7</td>
<td>9.4</td>
</tr>
<tr>
<td>Non</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
To test the first hypothesis I compare the MAPE of the statistical forecast that are subsequently adjusted with the MAPE of the unadjusted statistical forecasts. This test indicates that the statistical forecasts that are most in need of improvement are adjusted accordingly \((t(10) = 8.15, p < 0.00)\) and supports the first hypothesis (H1 supported). Moreover, in general the MAPE of the statistical forecasts that are chosen for adjustment \((M = 23.61, SE = 1.35)\) are significantly higher than those not chosen for adjustment \((M = 2.5, SE = 1.5)\). Notice that only two statistical forecasts in the sample are not adjusted. Therefore, there should especially be taken care in generalizing the findings.

To test the second and third hypotheses I compare the MAPE of the statistical and adjusted forecast for both the individual observations overall and the positive and negative adjustments separately. Overall, the average MAPE of the adjusted forecast \((M = 18.63, SE = 2.37)\) is significantly \((t(428) = 5.42, p < 0.00)\) lower than the MAPE of the statistical forecast \((M = 25.39, SE = 2.32)\). This test supports the second hypothesis that judgemental adjustments of statistical forecasts improve forecast accuracy (H2 supported).

For the positive adjustments \((M = 22.38, SE = 5.16)\) there is no significant improvement of the statistical MAPE \((M = 24.87, SE = 4.58, t(190) = 1.26, p > .05)\). In contrast, the negative adjustment significantly improves the statistical forecast in terms of MAPE \((M = 15.73, SE = 1.05; M = 26.01, SE = 2.01, t(235) = 6.51, p < 0.00)\). This supports the third hypothesis that the negative judgemental adjustments improve the forecast accuracy more than positive judgemental adjustments (H3 supported). This finding is consistent with the results of previous research (cf. Fildes et al., 2009; Syntetos et al., 2009).

To investigate if larger adjustments to the statistical forecast improve forecast accuracy more than smaller adjustments (hypothesis 4) I define larger adjustments as those adjustments that deviate more than 10% of the statistical forecast, and small adjustments as those adjustments that deviate less than 10% of the statistical forecast. There are 263 adjustments less than 10% and 164 adjustments larger than 10%. The analysis show that, on average, the larger adjustments \((M = 16.61, SE = 3.09)\) improve the MAPE of the statistical forecast more than smaller adjustments \((M = 0.68, SE = 0.30)\). The improvement of forecast accuracy due to larger adjustments is significantly better than small adjustments \((t(166) = -5.14, p < 0.00)\) (H4 supported).

I have already shown that positive judgemental adjustments of the statistical forecast do not significantly improve the forecast accuracy. Therefore, I test the fourth hypothesis also for positive and negative adjustments separately. These tests show that the improvement of forecast accuracy due to larger negative adjustments is significantly better than small negative adjustments \((M = 25.14, SE = 3.68; M = 1.45, SE = 0.41, t(89) = -6.40, p < 0.00)\). Between smaller and larger positive adjustments there is no significant difference \((M = -0.30, SE = 0.42; M = 6.73, SE = 4.90, t(76) = -1.43, p > 0.05)\).
To test the fifth hypothesis I compare the statistical forecast group that has a higher than average forecast error (MAPE) with those that have a lower than average forecast error (MAPE), and investigate if the forecast accuracy improvement due to the judgemental forecast adjustment differs for both groups. The analysis show that the effect of judgemental adjustment on improving statistical forecast accuracy is significantly ($t(143) = 9.58, p < 0.00$) higher for statistical forecasts that have higher than average MAPE ($M = 28.06, SE = 3.10$), than for statistical forecasts that have lower than average MAPE ($M = -2.2, SE = 0.78$). Notice that adjusting statistical forecasts that are characterized as low volatile on average reduce forecast accuracy. This shows that adjustments are correctly made to statistical forecast that are concerned with high variability. Moreover, adjustment is applied when it is most needed, i.e. under high volatility that is the result of factors not captured in the statistical model (H5 supported).

Two methods that are proposed in literature to test the hypothesis that the judgementally adjusted forecasts are positively biased (hypothesis 6). Theil’s method and the binomial test method respectively. Theil’s method could not be conducted because the assumptions to conduct regression analysis are violated. The binomial test is used to determine if the percentage of adjustments that result in forecasts greater than the actual are significantly different from the 50% figure we expect if the forecast were unbiased. The results of the binomial tests are shown in Table 5.4. The results show that the judgementally adjusted forecasts are positively biased (H6 supported). This is consistent with the belief that there is a tendency to overforecast and introduce positive bias within Vistaprint’s forecast process because the forecast is seen as a target and organizational policies prescribe not to run out of stock.

To test the two sub-hypotheses of hypothesis 6 I conduct the binomial test for the negative adjustments and positive adjustments separately. The results of the test are shown in Table 5.4 and show that the negative judgementally adjusted statistical forecasts are not significantly different from the 50% figure (H6a partially supported). In contrast, the positively judgementally adjusted statistical forecasts are biased (H6b supported). This result is consistent with the findings of Fildes et al. (2009) that positive adjustments are often too optimistic (i.e. positively biased).

<table>
<thead>
<tr>
<th>Direction of adjustment</th>
<th>N</th>
<th>Adjusted Forecast &gt; Actual (%)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive and Negative</td>
<td>427</td>
<td>57</td>
<td>&lt;0.01 (one-tailed)</td>
</tr>
<tr>
<td>Positive</td>
<td>191</td>
<td>62</td>
<td>&lt;0.001 (one-tailed)</td>
</tr>
<tr>
<td>Negative</td>
<td>236</td>
<td>54</td>
<td>n.s.</td>
</tr>
</tbody>
</table>
An overview of the hypothesis and their findings is shown in Table 5.5.

**Table 5.5 Overview of hypotheses**

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Outcome</th>
<th>Insight</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1. The statistical forecasts selected for adjustment are those most in need of improvement</td>
<td>Supported</td>
<td>Forecasters are able to adjust the statistical forecast that are most in need for judgemental input. Indicating that forecasters have knowledge that is not captured in the statistical model.</td>
</tr>
<tr>
<td>H2. Judgemental adjustments of statistical forecasts improve forecast accuracy.</td>
<td>Supported</td>
<td>Judgemental adjustment is of value to the forecast process (i.e. judgemental adjustment improves accuracy).</td>
</tr>
<tr>
<td>H3. Negative judgemental adjustments of statistical forecasts improve forecast accuracy more than positive judgemental adjustments of statistical forecasts.</td>
<td>Supported</td>
<td>Negative judgemental adjustments are more effective than positive judgemental adjustments.</td>
</tr>
<tr>
<td>H4. The sizes of the judgemental adjustments are positively associated with an improvement in accuracy</td>
<td>Supported</td>
<td>Larger judgemental adjustment should be continued while smaller judgemental adjustment should be more careful considered before carried out.</td>
</tr>
<tr>
<td>H5. Judgemental forecast adjustment improves the forecast accuracy more under high volatility than low volatility conditions.</td>
<td>Supported</td>
<td>Under stable demand patterns statistical forecasts outperform judgementally adjusted forecasts.</td>
</tr>
<tr>
<td>H6. The judgementally adjusted forecasts introduce positive bias.</td>
<td>Supported</td>
<td>Organizational politics should be kept in mind when adjusting and interpreting the adjusted forecast.</td>
</tr>
<tr>
<td>H6a. The negatively judgementally adjusted forecasts are not biased.</td>
<td>Partially Supported</td>
<td>For negatively judgementally adjusted forecasts bias is not an issue.</td>
</tr>
<tr>
<td>H6b. The positively judgementally adjusted forecasts are positive biased.</td>
<td>Supported</td>
<td>When positive adjustments are applied correction for bias should be considered.</td>
</tr>
</tbody>
</table>
6. Discussion

6.1 Theoretical Contribution
The research results show that forecasters are able to adjust the statistical forecast that is most in need of adjustment and the adjustments, on average, positive influence the forecast accuracy.

The research results show also that judgemental adjusting statistical forecast can both decrease and increase forecast error. In specific, it empirically shows that statistical forecast performance in terms of forecast accuracy was improved when negative judgementally adjusted. In contrast, the statistical forecast performance was not significantly improved when positively judgementally adjusted. This indicates that the contextual information on which the negative adjustments are based is reliable and that the information on which the positive adjustments are based is less reliable.

Furthermore, it is proven that large adjustments (>10%) to the statistical forecast improve the statistical forecast accuracy more than small adjustments (<10%). This indicates that the information on which the large adjustments are based is reliable and that the information on which the small adjustments are based is not reliable.

Given that 99.5% of statistical forecasts is judgementally adjusted, 61% of these adjustments are small, and 20% of these adjustments are large and negative the judgemental adjustment can definitely be improved by reducing the extent to which judgement should be used.

In conclusion, the research findings provide evidence for both the fallibility of human judgement as well as the value of human judgement. The key finding is that large judgemental adjustment can significantly improve the statistical forecast accuracy. Indicating that forecasters have reliable information other than captured in the statistical forecast that influence future demand. Small adjustments do not or almost not improve the statistical forecast accuracy. Indicating that forecasters make adjustments that are not based on reliable information. Therefore, statistical forecasting should only be combined with judgement when judgement is based on reliable contextual information. In addition, the results show that under stable demand patterns statistical forecasts outperform judgementally adjusted forecasts.

These findings implicate that the reliability of the contextual information that forecaster provide to adjust statistical forecasts must be clearly evaluated to make sure that only those adjustments are made that minimize the forecast error.
6.2 Managerial Implications
How can Vistaprint optimize the use of statistical and judgemental forecasting to minimize the forecast error? According to the theoretical review and empirical findings, integration of judgemental and statistical methods can minimize the forecast error. However, the extent to which judgement should be used and when to make judgemental adjustments to the statistical forecast should be carefully considered. Vistaprint’s current forecast performance can be improved by: avoiding small adjustments, avoiding adjustments if demand is characterized as low volatile, and correcting for organizational politics.

Avoiding small adjustments and avoiding adjustments of low volatile demand patterns can be simply established by forbidding forecasters to make those adjustments. As shown, this can result in low sense of ownership and will not stimulate organizational learning and organizational consensus. Therefore, I first recommend Vistaprint to include feedback regarding the performance of the judgemental input as shown by the red dotted line in Figure 6.1. Documenting the reasons for judgemental adjustments can help forecasters to understand the reliability of the contextual information on which the adjustments are based and reduce the tendency to make gratuitous adjustments accordingly (Goodwin, 2000a). Moreover, feedback regarding performance of past adjustments can validate whether reasons for applying judgements were justified and determine if future adjustments in similar circumstances are likely to be worthwhile (i.e. improve forecast accuracy). In addition, documenting the reasons for adjustment can create visibility throughout the organization, provide consensus and overcome ‘islands of forecasting’. Furthermore, it clarifies the organizational politics that influence the forecast. In sum, managers should consider both the fallibility and the strength of human judgement.

![Forecasting Framework](Image)

Figure 6.1 Forecasting Framework (based on: Silver et al., 1998)
Second, I recommend Vistaprint to develop software that is designed to search a database for the most similar events (e.g. promotion for a particular channel) with their effects might help forecasters to avoid problems associated with judgement. A more structured and rigor forecasting process, as shown in Figure 6.1, that supports effective judgemental adjustment avoids ping-ponging, i.e. continuous adjusting the statistical forecast without improving the forecast accuracy. This results in a more efficient planning process that needs less resources as well.

Finally, I recommend to use the following evidence-based guidelines to optimize the use of statistical and judgemental forecasting to minimize the forecast error.

- A small committee should be responsible for the judgemental input;
- The membership should include an individual with a broad organizational perspective as well as representatives from all departments affected by the forecast;
- The membership should include an individual that is knowledgeable in the statistical aspects of forecasting;
- The committee should be concerned with a properly defined set of products;
- Starting point should be the aggregated (statistical) forecast across the set of products;
- The committee should be able to easily adjust the aggregate forecast;
- The judgemental process should be well structured;
- Reasons for judgemental adjustments should be structurally documented;
- There should be given feedback to the performance of the judgemental input.
- Balance the costs of forecast errors made versus the costs of generating forecasts.

If Vistaprint sticks to those recommendations the statistical and judgemental forecasting can be optimized to minimize the forecast error.

6.3 Limitations and Future Research

This research has some limitations. First, the research is conducted within one single company. The expertise of the employees involved in forecasting, the forecast approach used, and the statistical methods used could influence the results. For instance, given the large number of employees involved in the forecasting process it is not likely that they all are knowledgeable in the statistical aspects of forecasting. I cannot be sure that the results apply to companies where more statistical knowledgeable employees make adjustments. Furthermore, the statistical method used can have a large effect on the forecast accuracy. Therefore, this research cannot guarantee that the results apply to every organizational forecasting process. Second, I made use of monthly forecasts that are made on quarterly basis. It is likely that forecasters are better able to predict demand one month ahead than two or three months ahead. I did not control for this possibility. Third, in the introduction is mentioned that the marketing strategy is changing. This can provide an explanation for judgemental adjusting the statistical forecast. However, there is not controlled for events that can validate an adjustment. Fourth, the research is conducted at the product group
level. Forecast accuracy at product group level does not necessarily guarantee forecast accuracy at the underlying product level because underforecasting and overforecasting can cancel each other out at the product group level. Therefore, the results at the product group level should not simply be applied to the individual product level. Fifth, the effects of characteristics of product group characteristics are not considered in the analysis. For instance, when forecasting seasonality months there is made use of other statistical forecasting methods. It is not investigated if these changes influence the results. Finally, I only compared the statistical forecast with the ‘final’ adjusted forecast. However, the statistical forecast is first adjusted by product marketing and then by channel marketing. For instance, it is not investigated if the adjustments of product marketing effect the adjustments of channel marketing. The findings can only be associated to the ‘final’ adjustment. Overall, there are many confounding factors possible that could limit the generalizability of the results.

In order to test and verify the accuracy of findings in this research direction more research in different settings is definitely needed to prevent for confounding factors. There could, for instance, be investigated if re-designing forecasting software such that judgemental adjustment could be more easily integrated with statistical forecasting increases forecasters perceived ownership and forecast accuracy accordingly. Moreover, the question how to integrate quantitative forecasting methods with judgement more effective provides definitely avenues for future research. For instance, should integration be automated or voluntary applied by (experienced) forecasters?

Furthermore, the reason that theoretical perfect statistical forecast methods do not result in the expected performance improvements (i.e. higher forecast accuracy) in practice needs more investigation. Is there a lack of statistical forecasting competencies in organizations that hinders effective integration of statistical and judgemental forecasting? Önkal (2009) suggests that with no or limited statistical forecasting knowledge of employees involved in the forecasting process how could they be expected to understand and rely on the reasoning behind the statistical forecast?

Finally, a longitudinal study could be conducted at Vistaprint to investigate if the proposed forecasting process that provides feedback to the judgemental adjustment results in the expected improvements.

### 7. Conclusion

This research provides deeper insight in the value of judgemental and statistical forecasting by investigating the influence of judgement on the forecast accuracy in an organizational setting. Building on a forecasting framework and research that recognizes the importance of human behavior in the forecasting process, I developed eight hypotheses mainly to investigate the influence of judgement on the forecast accuracy. As an important insight,
the research shows that 99.5% of statistical forecasts are judgementally adjusted. Testing the hypotheses, I conclude that:

- Forecasters have knowledge that is not captured in the statistical model;
- Judgemental adjustment can improve forecast accuracy;
- Negative judgemental adjustments of statistical forecasts improve forecast accuracy more than positive judgemental adjustments of statistical forecasts;
- Larger adjustments improve the forecast accuracy far more than smaller adjustments;
- Under stable demand patterns statistical forecasts are more accurate than judgemental adjusted forecasts;
- Under high volatile demand time series judgemental adjusted forecasts are more accurate than statistical forecasts;
- Positively judgementally adjusted forecasts are concerned with overforecasting.

In sum, to provide the most accurate forecasts the best of two worlds must be integrated. Driving on the statistical forecast under stable demand patterns and only applying judgemental adjustments when there is sufficient effiidence that it improves the forecast accuracy. Ultimately, correctly applying judgemental adjustment helps Vistaprint to improve their forecasting performance as part of achieving their big hairy audacious goal.
References


Appendix A – Forecast process flow model

<table>
<thead>
<tr>
<th>Forecast Setup</th>
<th>Data Preparation</th>
<th>Forecast Activity</th>
<th>Manufacturing Split</th>
<th>Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Data Setup (optional)</td>
<td>Manual Data Adjustment</td>
<td>Dashboard File Preparation</td>
<td>Apply Manufacturing Split</td>
<td>Reporting</td>
</tr>
<tr>
<td>Forecast Setup</td>
<td>SAS import data processed into data table</td>
<td>Excel Dashboard files</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product Mapping Initialization</td>
<td>SAS import table on database</td>
<td>Product Manager Data Input</td>
<td>Adjust Manufacturing Split Percentage</td>
<td></td>
</tr>
<tr>
<td>Product Mapping Adjustment</td>
<td>SAS export table on database</td>
<td>Run Rate Swappin</td>
<td>Generate Manufacturing Split Percentages</td>
<td></td>
</tr>
<tr>
<td>Forecast Group Initialization</td>
<td>SAS Export</td>
<td>Marketing Stretch Setup</td>
<td>Manufacturing Product Setup</td>
<td></td>
</tr>
<tr>
<td>Forecast Group Adjustment</td>
<td></td>
<td></td>
<td></td>
<td>Tracking Report</td>
</tr>
</tbody>
</table>
Appendix B - Exploratory interviews

Plan director Venlo

Aligning of organizational functional (i.e. manufacturing, capabilities, marketing) can generate advantages (i.e. cost reductions).

S&OP manager

A forecast will never be accurate. Currently, it is difficult to address the process. The forecast is treated as a financial exercise. The forecast is not always useful to supply chain. There are no procedures, scenarios or structural process in place that help to efficiently plan and control demand. Furthermore, there are no mechanisms for managing demand. Hedging strategies are provided to manage demand. This entails that difficulties are evaded by reserve capacity and safety stock. These strategies entail unnecessary costs. Finally, the supply chain should become more responsive.

Supply Chain Director

It is all about the forecast accuracy. Marketing needs to provide an accurate forecast. Contact between my department and marketing occurs only if it is really needed. Contact proceeds by e-mail or telephone. For instance, when a machine is down or maintenance is needed and it affects capacity marketing is informed. Furthermore, if we provide marketing with actual figures they do often not act on it. Another annoyance is that I am, as Supply Chain Director, judged on my stock levels. However, I am required not to run out of material (and therefore required to have a huge amount of safety stock). If marketing’s forecast is not accurate I often have too much or too little material on stock with unnecessary costs as a consequence. Because I cannot trust marketing I tell my people to keep stuck to our own plans. Overall, marketing is the problem.

Material Manager

I regular ask marketing questions via e-mail or telephone. I receive a demand forecast once in a quarter from the finance department. If the forecast is not accurate I ask the responsible product marketer for a revision of the forecast. Sometimes I receive a revision but sometimes I also do not receive a revision or even a response. The response I receive also depends on the marketer. The mutation among marketers is also very high therefore I often have to explain again why I ask certain questions. However, in an ideal world marketers should be in the lead (i.e. provide us with information) instead of that we (i.e. supply chain) continuously ask for information. My perception is that marketers do often not know what they are doing. I am acting in a very ad hoc and informal manner but I think not that I will benefit from a very formal process or whatsoever. Finally, to my opinion the different departments are working in silos.
New Product Engineer

I am often involved in new product projects. My responsibilities are mainly to guide the facility and feasibility of new product introduction. This requires definitely cross-functional collaboration. During a project I have regularly contact with marketing and manufacturing employees. The contact with the project leader was fine but when there are certain issues it is often unclear who is responsible for solving the issue. Although there is a project team with clear stakeholders when there is an issue many colleagues of diverse functional areas are interfering in discussions. For instance, if someone addresses an issue by e-mail there are so many recipients added with many conversations as result that information is often duplicated or sent to the wrong person. If there is a manufacturing issue they (i.e. manufacturing/operational managers or supervisors) incorrectly assume that we will solve the problem. In fact, it is their own responsibility to solve the problem or provide us (i.e. engineering) with questions how to solve the problem instead of assuming that it will be directly solved by engineering. Furthermore, if there is an issue we often really need to convince manufacturing that they need to act in a more efficient manner. However, if something is going wrong engineering is blamed. Also, marketing does not feel the pain if something is going wrong. For instance, if there needs to be done an investment on basis of the marketing forecast we always have our doubts because marketing always overstates the actual demand. But finally we are accounted for the acquisition. How this can be solved? Please, tell me! But the alignment of marketing employees intern and with marketing (i.e. cross-functional alignment) can definitely be better. To my perception the marketing executives do not know what is going on and only get to known desirable information from their subordinates. Furthermore, how marketing is rewarded is in conflict with our objectives and that they are located at Spain is also not ideal. In addition, projects are most often fist managed by global teams located in Switzerland and America, but they (i.e. global teams) do not see what really is going on in reality (i.e. manufacturing at Venlo) and therefore do not understand or endorse the problems. Overall, the introduction of new products can be much better. If there is a more understandable process in place with clear responsibilities and stages it will definitely help to more smoothly/efficiently launch (new) products. At my previous employer (ASML) everything was strictly structured. Too strictly for me, but Vistaprint could definitely be helped with some structured processes. However, everyone is busy and there is therefore almost no time to make processes more efficient.

Analytics manager

Our golden rule is to produce every incoming demand and preferably in such a way that it is shipped on time. For most of the products we are able to predict the demand on daily basis very accurately because of historical data and known demand trends. We are well capable to control the shop floor in such a way that demand is produced in a steady way. However, sometimes we are certainly exposed to an immense increase in demand or a demand that is constantly above or below our expectations. In such a situation we contact the
manufacturing and supply chain director, who additionally contacts marketing and asks for possible reasons of demand increase and what can be expected in the upcoming time. In addition, action is taken to keep control. We provide analysis of possible scenarios in an ad hoc manner to support decision making. I believe that a thorough insight in the life time of products and a segmentation approach of products regarding there forecast ability and revenue generation can significantly help to increase the focus on those products that negatively affect customer service (i.e. on time and fast delivery) and stock levels.

Marketing representatives

During a workshop between the S&OP manager and marketing representatives there are set some marketing expectations about how to increase the collaboration between marketing and manufacturing and supply chain. These expectations are:

- Create visibility (on critical products);
- Understanding dependencies between functional areas;
- Align and systemize communication;
- Common scenario planning;
- Increase incentives to collaborate.

The expectations of the marketers show that there is little known about the relationship between marketing and supply chain and manufacturing. Marketers do not have visibility of the impact of their actions on supply chain and manufacturing. And they do not know how the organization can benefit from collaboration between functional areas.
Appendix C – Company background

History
It all started with the identification of an unsolved customer need in 1995 by Vistaprint’s CEO Robert Kean. Robert Kean identified the need of micro-businesses for designing and printing promotion materials such as brochures and stationary in low volumes and at low costs. After writing a business case around this need and the predecessor of Vistaprint was born. A few years later the potential of reaching more and more customers by the World Wide Web has been recognized. It would become even more easy for customers to create their designs and order direct from their PCs instead of ordering via a catalogue. However, to realize this potential of the World Wide Web there is made use of ingenious patented technology and revolutionary marketing. First, software has been developed that made it possible for customers to upload their own designs and did not need to be installed on a customer’s PC to be used, but ran in the browser itself. Second, a radical innovation in production has been realized. This is based on continuous pursuit of Vistaprint’s original business vision that low volume and high quality should not be synonymous with high cost. At the moment customers confirm an order it is grouped in batches of orders of products with similar properties. This results in producing small order sizes in a high volume manufacturing process drastically reducing the costs of set-ups, labor, raw material, and overhead. Ever since then Vistaprint is expanding its business.

Business structure
Vistaprint divides its business in two main business units that each entail two markets based on their geographic location. The first unit is the traditional business unit. This unit is divided in the North America and European Market. The majority of Vistaprint’s revenues come from North America and Europe, they account for 90 percent of anticipated revenues in financial year 13. Respectively, 50 percent for North America and 40 percent for Europe. Recently, Vistaprint started to expend their business beyond North America and Europe. This unit is referred to as Most of World and is roughly divided into two markets. The so called JANZ market, including Japan, Australia, and New Zealand. The other market entails the rest of the world whereby the focus is on India, and China. Figure C.1 provides an overview of business units. In addition to these units there are two relatively autonomously operating units. These are the companies Albumprinter, based in Amsterdam and The Hague (the Netherlands) and Webs, based in Silver Spring (Maryland, USA). These companies are acquired in calendar year 2011 in order to expand into business models that are adjacent to the core business but unique. Albumprinter is a European leader in high quality custom photo books and Webs is a leader in small business websites that are marketed under a freemium business model.
Corporate structure
Vistaprint N.V. has a two-tiered board structure typical of publicly-traded Dutch companies, consisting of a management board and a supervisory board. These two boards are responsible for the corporate governance structure of the company and compliance with the Dutch corporate governance code.

Supervisory Board
The role of the supervisory board is to supervise the policies of the management board and the general affairs of the company and its affiliated enterprise, as well as to assist the management board by providing advice. Shareholders elect the members of the supervisory board.

Management Board
The role of the management board is to manage the company, which means among other things, that it is responsible for achieving the company’s aims, strategy and policy, and results. The management board is accountable for this to the supervisory board and to the general meeting of shareholders. Shareholders elect the members of the management board.

Global Executive Team
The Global Executive Team (GET) represents all functional areas of Vistaprint, including the Most of World business unit. An overview of the GET is given in Figure C.2. The purpose of the GET is to drive: (1) the rolling five year strategic plan and successful development of our strategies, (2) the on-going executive talent development of the Global Leadership Group, (3) our organizational development, culture, and communication, (4) visible leadership for the organization, this includes communication and execution of the strategy and emphasize the importance of customer.

**Figure C.1** Overview of Vistaprint’s business units (source: Vistaprint intern documentation)
Although the markets are geographically segmented and there are clear distinct functional areas around which the firm is organized the organization is cross-functional oriented and serving customers in any market relies on a network of team members from different functions across the globe. Therefore, I will define the mission of each functional area separately and define where the functional areas are most dominant located.
Figure C.2 Overview of the global executive team representing all functional areas (source: Vistaprint intern documentation)
Functional areas and their mission

Marketing
Marketing is ultimately responsible for growing revenue and achieving the plan of 2 billion dollar in 2016. The marketing teams are located in Barcelona and Lexington for respectively the European and North America market. The marketing teams are responsible for understanding customer needs, development of strategies to meet customer needs, and drive growth to market activities in their specific region. Besides these teams there are several design, sales and service teams around the globe that are part of the marketing function. These teams are located in Berlin (Germany), Montego Bay (Jamaica), Mumbai (India), Sydney (Australia), and Tunis (Tunisia) to provide customer service. Among others, they answer emails and telephone calls from customers around the world. In addition, these teams help to understand customer feedback (e.g. complaints) and (latent) needs.

Capabilities
Capabilities mission is to combine people, processes, and technology to deliver strategic business outcomes. The team is comprised of approximately 400 people. Most of these people are located in Lexington. The capability team works across a diverse set of domains of expertise such as, software engineering, project management, architecture, quality, operations, and strategy. The capabilities goal is to enable great customer value and business results by working cross-functional to bring different stakeholders within the company from concept through design, development, deployment, and continuous improvement in the following areas: (1) physical and digital product development, (2) online marketing systems, (3) web experience and commerce, (4) customer facing product design tools, (5) manufacturing operating systems, (6) emerging market business enablement, (7) business intelligence, (8) technical infrastructure and operations, (9) corporate systems.

Manufacturing and Supply Chain
Manufacturing and Supply Chain’s mission is to become the leading manufacturer of mass customized print products worldwide that impress the customers with the speed, price, and quality of product delivery. Vistaprint’s production facilities are located in Venlo (the Netherlands), Windsor (Canada), Bhiwandi (India), and Deer Park (New Zealand). Besides these production facilities there are supporting facilities located in Winterthur (Swiss), Lexington, and Hong Kong. Altogether, this functional area counts around 1700 people.

Finance
Finance’s mission is to provide value-added strategic and finance support to the company that improves the speed and quality of decision making, ensure control and regulatory compliance, maximize long-term shareholder value, and manage company and shareholder risk. The tasks of the financial team of around 150 people worldwide include: accounting and manufacturing finance, corporate strategy, investor relations, tax, marketing finance, corporate financial planning and analysis.
Human Resources
Human Resource’s mission is to support delivery of Vistaprint’s vision, strategy, and business objectives.

Legal
The mission of Legal is to provide highest quality legal advice and services to the business worldwide, and across all levels of the organization.

Most of World
This business units mission is to lead and grow Vistaprint’s business outside of North America and Europe. The Most of World unit is operating relatively independent.

Autonomous Business units
Webs and Album printer are two acquired companies that operate relatively autonomously in order to build on Vistaprint’s distinct business models and strategies. Together they employ around 220 people.

Overview of Vistaprint sites
There are around 4400 employees located in eighteen sites in thirteen different countries. Furthermore, there are three locations that act almost independently. In Figure C.3 is an overview given of all Vistaprint sites.

Figure C.3 Overview of Vistaprint sites (source: Vistaprint intern documentation)

Competitive advantage
Three core competencies can be addressed. Respectively, Marketing, Capabilities, and Manufacturing. These three fields give Vistaprint significant competitive advantage over other companies in the field. They also provide barriers to entry for (new) competitors. These barriers are: significant scale and cost advantage due to high daily order volume;
Products and Services

Vistaprint’s product range is intended to help small businesses market themselves and record sentimental moments in Home and Family. To do so, Vistaprint offers affordable, easy to use marketing materials including business cards, brochures, car door magnets, lawn signs, promotional pens, hats, calendars, websites, and more. Typically, Vistaprint’s products and services match to form a coordinated turnkey marketing solution. Currently, there are over 60 products with thousands of supporting design templates.

Furthermore, Vistaprint offers automated matching products. This entails leveraging the content elements (e.g. logos, company names, and photos) that a customer uses in the core identity product to automatically match and adapt that content across a wide selection of other small business marketing products. These automatically designed products should generate a great experience for customers. Moreover, Vistaprint offers customers the ability to look professional without occurring the cost, time delay and hassle of finding a graphic designer and multiple vendors for multiple types of products.

In addition, Vistaprint’s resounding lead in terms of order volumes means that they are a low cost producer. Due to its ingenious technology the unit costs are very low and therefore can offer very competitive prices. In Figure C.4 are the top ten products by revenue in financial year 12 shown.

Figure C.4 Top ten products by revenue in financial year 12 (source: Vistaprint intern documentation)
Customer segmentation
Within Vistaprint there are distinguished resellers and non-resellers.

Resellers are customers who resell Vistaprint products (to make profit out of it). Resellers can be, for example, creative professionals, marketing agencies, and wholesale printers. Reselling can be through a resellers own website, as well as Vistaprint’s website, and a physical store. Resellers can basically be classified into four programs.

Namely, first Pro Advantage, this program gives customers the capability to buy wholesale unbranded products and resell those products with a premium.

Second, retail online or reseller online, this program creates a possibility for resellers to make use of/integrate the Vistaprint website in their own environment. There can be distinguished two possibilities. An integrated website, so called white label offering, this allows the partner to integrate a rebranded version of Vistaprint’s website with their own website. The other possibility is a standalone website, so called grey label offering, this allows the partner to provide their customers with a completely rebranded version of Vistaprint’s website. Overall, in this context resellers are part of a Strategic partnership and have a contractual relationship with Vistaprint that requires setting retail as well as wholesale prices. The main difference between the white and grey label is that the grey label needs no (complex) integration effort in contrast to the white label.

Third, Retail, also called Reseller In-Store, is a kiosk offering intended to be used in partner retail locations. The offering that is used within a kiosk is similar to the possibilities of the retail online offering.

Fourth, co-branding partner this program includes the placement of another company’s name on Vistaprint’s packaging, advertising, or website. The goal is to act as being the partner company, while Vistaprint themselves provide the underlying goods or services.

Non-resellers are customers who use Vistaprint products or services only for personal use, i.e. they do not resell Vistaprint products. Within the non-resellers there are distinguished three segments.

Consumer segment
The consumer segment consists out of customers who use Vistaprint only for personal use products. Some common examples of these products are all kind of invitations and holiday cards.

Freebies segment
The freebies segment is made of customers who are buying for their businesses, but are really only looking for free or extremely cheap products. These customers often take advantage of our free offers, and are very resistant to product upgrades (such as paper
stock or blank backsides for business cards). While these customers are business owners, they also do buy some personal use products.

**Active Marketers segment**
The active marketer segment is comprised of customers who are buying products for their business, and are willing to spend more money for added personalization or higher end products. Within this segment, there are defined three sub-segments.

**Accomplished Marketers**
The accomplished marketers are businesses that have been marketing themselves for some time, and have large marketing budgets. These customers come to us not for business cards, but rather for postcards, brochures, and data sheets. These customers buy in high quantities, and often upload their designs.

**Shared Marketers**
Like the Accomplished Marketers, the Shared Marketers have been marketing themselves previously, and also have large marketing budgets. However, unlike the Accomplished Marketers, the Shared Marketers use Vistaprint primarily for business cards, and have their postcards, brochures, and so forth printed at competitors. Therefore, Vistaprint literally 'share' them with the competitors.

**Emerging Marketers**
Unlike the other active marketer subsegments, the emerging marketer segment is comprised of businesses that are newer, or are just beginning to learn how to market themselves. Many of these customers are creating their brand identity for the first time on Vistaprint’s web site, and look for Vistaprint to provide guidance on how they should create their products.

In conclusion, this segmentation based on resellers and non-resellers provides a rough overview of Vistaprint customer groups. Nevertheless, there are more segmentations possible and used within Vistaprint.

**Company Strategy**
Vistaprint’s high-level annual corporate strategy is described using a strategic pyramid as shown in Figure C.5. The pyramid visualizes how the long-term vision is connected to the medium-term tactics and short-term practices.
Figure C.5 Vistaprint’s strategic pyramid, representing the corporate strategy (source: Vistaprint intern documentation)

The pyramid consists of four company-wide layers, supported by a fifth layer which is the foundation of individual employee goals.

**Vision and enduring values**

The vision and enduring values represent the long term objectives.

First, corporate vision. Vistaprint has realized a rapid growth ever since it is founded in 1995. And the goal is to keep up that growth. Second, enduring values. The enduring values represent what is needed to keep up that growth. Moreover, they are both a description of the culture and targets for how to work individually and together. There are six enduring values formulated that I discuss accordingly.

**Audacious goal**

Ever since the beginning of Vistaprint audacious goals have been set, and have almost ever been realized. The audacious goal, i.e. medium term objective, that now has been set is reaching 30 million loyal customers by 2020. Where loyal customers are defined as customers who return and buy products from Vistaprint’s portfolio again.
Rolling 5-year strategic plan (FY 2012 to FY 2017)
The rolling five year strategy representing the short-term strategy entails reinvigoration of growth in the core business, laying foundations for future growth. This entails, having a long term view on earnings and increasing multi-year resources. This should be accomplished due to three key initiatives for growth (KiFG). These are Value to the Customer (V2C), Manufacturing as a Third Pillar of Competitive Advantage (M3P), and Life Time Value Marketing (LTV).

Value to the Customer
At V2C’s core stands the customer. It is Vistaprint’s aim to improve, change, and innovate products, as well as processes (both customer facing and internal) and customer treatments by addressing the customers core needs to optimize their lifetime value.

Value to the Customer serves as the umbrella strategy that building on existing strengths will bring Vistaprint closer to the customer in decision making, thinking, and in processes. Vistaprint has built a very successful company focusing on optimizing short term profitability at the session level. Due to the manufacturing capabilities there is a very strong value proposition that attracted many customers to the website. With V2C Vistaprint is embarking on a paradigm shift, away from optimizing each session (i.e. manufacturing active paradigm) towards embracing the customer in decision making (i.e. customer active paradigm).

Vistaprint strives to change the metric of success from optimizing short term profitability on order level to optimizing profitability on Customer Lifetime Value, i.e. total amount of revenue attributed to a single customer since they became a customer. In addition, Vistaprint strives to develop not just a great product at a great price but to also a great end-to-end customer experience. This includes understanding of customer (latent) needs, and determine which needs can be executed using (current) strengths of people, process and technology that provide clear, compelling value to the customers. This customer value should provide multi-dimensional improvement: better quality, faster delivery, higher convenience, much lower price, better design, all at once. Delivering this value through organizational capabilities which are inherently much more efficient than methods used by competitors and which are difficult to replicate provide a barrier for competitors. The combination of providing multi-dimensional improvement in customer value with immense efficient organizational capabilities creates enormous competitive advantage and results in a so called disruptive business model.

Manufacturing as a Third Pillar of Competitive Advantage
The second key initiative for growth that Vistaprint wants to deliver is manufacturing as a third pillar. The term of manufacturing as a third pillar is to recognize that the direct marketing capabilities and the software based development capability Vistaprint has are the first two pillars.
In the 2002-2009 period, Vistaprint capabilities were software focused combined with unbelievable marketing. However, to stick to ambition of realizing tremendously growth in terms of revenue Vistaprint realized that it should do something more. They build a third pillar: manufacturing. This pillar focuses on achieving manufacturing excellence, and developing expertise in a whole range of disciplines including procurement, manufacturing engineering, software engineering and quality. However, there are a number of opportunities that Vistaprint identified to be even better than they are today to become world class in manufacturing. What are these opportunities?

The main aims of manufacturing are to achieve a step function improvement in:

- On-time, on-spec delivery to the customer,
- Quality attributes as valued by the customer,
- Unit manufacturing costs,
- Improving the click-to-doorstep throughput time.

With unit manufacturing costs in particular, there is an enormous opportunity to both improve quality and lower costs. This starts with supply chain management, and throughput models through the plant, not just the machine productivity. Improvements here will deliver, manufacturing enabled goals from V2C, which are believed to drive enormous revenue enhancement over a 5 year period. With an associated 25 percent reduction in manufacturing unit cost production.

**Lifetime value (LTV) based marketing**

LTV marketing represents a major evolution of Vistaprint’s marketing investment decision framework. It is a KIFG intended to increase revenue, market share and long-term financial returns. LTV combines well established financial discipline with the analytical rigor and direct marketing skills that are a core part of Vistaprint’s core capabilities. The initiative looks at customers from a financial perspective to understand the value of their cash flows over their lifetime as a customer with Vistaprint: their “lifetime value” or simply their “LTV.”

LTV enables Vistaprint to pursue a controlled expansion of their existing marketing portfolio to reach prospects beyond the lowest-hanging fruit of their traditional advertising channels like paid search and acquisition email. While those core channels remain a vital part of the acquisition portfolio, using a framework that allows to push up the average cost of acquiring customers means Vistaprint can go deeper into markets and channels that they have traditionally considered either “too expensive” relative to what else was out there or in other cases “too hard to track” – these include channels like online, display, direct mail, box inserts and broadcast.
Foundations for future growth beyond the core business
In addition to the three KIFG’s Vistaprint has three foundations for future growth. These are the strategic areas where Vistaprint believes they achieve considerable and sustained growth in future. These three foundations are:

Webs: freemium digital products
The acquisition of Webs provides the vehicle to be a leader in the Freemium Digital space. Vistaprint empowers Webs to function as a stand-alone brand and autonomous operating unit to learn about the digital market and grow freemium aggressively. Encouraging this part of the digital business is done to develop additional free offers, and, in particular, to pursue Pagemodo Facebook offers and to develop other products that can grow through rapid viral expansion. At the same time, there is also provided Vistaprint support and expertise to improve customer acquisition, upsell to premium paid digital products, and cross-sell to print products.

Albumprinter: European photo books and ‘sentimentalist’ market
The acquisition of Albumprinter will be similarly pivotal in driving the development of a future growth foundation. In addition to growing the strong B-to-B business, the team is mandated with building the Albelli brand via a premium positioning in the consumer space, targeting sentimentalist Home and Family consumers. In FY13 Albumprinter will pursue geographic expansion to the UK and to Nordic countries. As with Webs, it pursues an autonomous operating unit approach to maintain customer focus, and nimbleness, and to create a center of excellence in high-quality photo products.

India, China & SE Asia
In global emerging markets, there is taken a focused approach to the market opportunity, limiting the focus to Asia, and, within Asia, concentrating first and foremost on India and China, with a small effort in the Singapore market. In later years there is planned to expand to Southeast Asia, Taiwan, and Korea.

Current and next year priorities and initiatives
In this layer the strategy is turned into action, translating the vision and values into practical actions both globally and locally. With the goal that everyone in the organization, be it in different functional areas, understands how their contributions fit together.

Individual goals
People or Vistaprint employees are the foundation stones of the strategy. Therefore, individual goals and objectives should be aligned with the goals of corresponding functional areas that are aligned with the corporate long-term vision, medium-term tactics, and short-term programs.