Chapter 8: Data-driven investment strategies and portfolio management with predictive algorithms

8.1. Introduction

Many analytical tools run off-line and sit in the back room. Someone assembles, formats, and makes sense of the results, who may or may not have anything to do with the decision-making processes. Who sees the results, when, and what they can do with it are pretty much pre-determined. This pre-specified result is then presented to the decision makers who may or may not do anything about it. It is then a one-way communication, feedback is usually not immediate, and it is hard to know what bits and pieces of information are of interest. Interactive tools, on the other hand, allow decision makers to dictate the conditions under which information will be released and in what form. They allow managers to examine different scenarios with relative ease and provide a great deal of scope for tailoring the inputs and the formats required. They enable feedback to be instantaneous and the decision maker is in complete control. In some sense, interactive tools are more like dashboards compared with static analytical models (Few, 2006; Mishra et al., 2022; Rome et al., 2024).

While such tools have been around for some time, it is only relatively recently that they are being enthusiastically embraced by the analytical community in a wide variety of contexts. The tools available are becoming increasingly more sophisticated and are permitting a greater variety of functions to be performed interactively. This is particularly true with the development of workstations and other microcomputing platforms. These machines are rapidly approaching the point where they will be able to run complex models in real time, while offering sophisticated graphics capabilities. For applications where visual information processing is important, the use of graphical techniques can be as valuable as the development of an interactive, time-sharing capability Sharda et al., 2020; Tableau Software, 2021).

8.2. Understanding Key Performance Indicators (KPIs)

Key Performance Indicators (KPIs) play an essential role in every aspect of a company's evolution. Some companies are treated as a test case for the problem of growth. Such companies vary in both formulation and execution. They are differentiated from others due to the speed and magnitude of the results produced. They grow at rates that outperform their competitors, sometimes by a factor of over 15. They serve niche or underserved markets. They band together different product lines and services under the aegis of a consistent branding orientation. They practice strategic dynamics – adjusting their tactics and operational activities with a speed that outpaces their competitors. They make contact with their customers in the same manner in which customers search for solutions and conduct their own research.

Fig 8.1: AI in portfolio management

People frequently refer to KPIs as "the secret sauce" of high revenue growth companies. No wonder. High revenue growth companies have key elements in common. They have identifiable hubs, such as product catalog content, that become the magnet around which offerings and activities orbit. They have website performance that maximizes the traffic of people who sample their products, content, and services. Their home pages are designed to take advantage of drop-offs. They have an advertising acumen that identifies niches and uses the statistical tools of targeting and tracking metrics. They also have

insights for testing, monitoring, evaluating, and optimizing advertising effectiveness. KPIs make this possible.

8.2.1. Definition of Sales KPIs

Sales KPIs are quantifiable metrics that an organization uses to evaluate its success at reaching targets for sales activity. The concept defines KPIs as "a limited set of critical performance measures that provide senior management with a fast but comprehensive overview of the organization's health". Our interest is restricted to submetrics of the overall "success" KPI related to the achievement of profit or growth targets, such as revenue growth, operating profit growth, return on capital invested, return on investment, or shareholder value added for example.

There are several different sources we can rely on to create a list of relevant KPIs for the sales department. The most natural would be the financial control department, as the sales KPIs must roll up to the overall company success KPIs. Another source would be the sales management and the financial director, who would define what they believe to be the critical KPIs for the sales department. A company could also rely on benchmarks to select KPIs, based on lists provided by various entities.

At the overall company level, there is no objective selection of company KPIs possible, at least not on a theoretical ground. These KPIs are mainly chosen based on historical performance and what the organization's management believes makes sense for a particular period and company. However, once the sales management defines the important sales KPIs, these must result from a top-down approach, where specific objectives are set at different levels to align local sales objectives with the company's overall sales objectives.

8.2.2. Importance of KPIs in Sales Management

Sales KPIs are an essential tool in the sales management area. They comprise a series of quantifiable performance targets that link to key business objectives, the sales team in this case. Sales KPIs are a dashboard used for organizational performance management and are part of the single global performance management process applied by top performers. Sales KPIs are presented in dashboards that should be defined at the same level of specificity as the sales targets set for the sales team to have the desired effect. Sales KPIs act mainly on two different levels. On a first level, they clarify the motivation and incentives to be pursued by the sales team, providing an ongoing scorecard of results needed to gain bonuses or long-term performance-based compensation. On a second level, they help sales management to track sales activities and results. They are both used

to helicopter up the sales view and drill down issues, challenges, and opportunities. Are dashboards describing the aggregation of all the sales activities linked to the sales cycle within the territory? Are dashboards describing the identified opportunities and risks and all the resources deployed to investigate pursue, and close deals? Are dashboards that prioritize resources based on the teams' scorecards? Are dashboards to be checked on time as part of the performance management effort of the company? The approach to setting and managing sales KPIs differ according to the product/service and customer differentiation and market segment targeted. Some companies have very different sales KPIs for each market segment (typically large customers with a dedicated sales force, wholesalers, and small retailers). Some are substantially the same with gradual differences. Others provided the same tools for prioritizing resources with very different breakdowns – for each dedicated team and/or market segment – of the KPI activities tracked at sales cycle and sales deal level. In this last category of companies, the reporting used to be consolidated, up to the top reporting level, mainly on revenue.

8.3. The Role of Dashboards in Sales Analytics

Dashboards play an important role in the business domain, particularly in managerial decision-making support, such as financial management, sales management, operations management, production management, supply chain management, and marketing management. The sales function in any firm generates revenues, while other functions consume those revenues. Thus, sales managers, business unit managers, or functional heads need information to monitor their sales performance, implement corrective actions proactively, or take motivational measures in order to accomplish sales targets. Dashboards facilitate displaying information in a user-friendly manner. Using dashboards is useful in the sales domain because they integrate information and display it graphically via a single user interface. This would help decrease the sales manager's cognitive burden as compared to viewing the same information on multiple sources, thereby improving information monitoring/processing efficiency. A dashboard is a data visualization tool that presents key performance indicators (KPIs) and metrics to help an organization track, analyze, and manage the progress of its business objectives.

Dashboards display business intelligence (BI) data extracted from the organization's internal systems or from external sources, or a combination of both. This data is retrieved through data integration techniques, particularly data warehousing and ETL. Dashboards can be divided in terms of frequency, by the source of data from which they are fed, the consumers, the extent of use of some components, the target of the displayed data, and, obviously, their content. Dashboards can show data at different levels of granularity, depending on their destination: aggregated data on corporate dashboards, for example

using variables processed in a data warehouse, while data at the operational or department level on tactical or operational dashboards.

8.3.1. Types of Dashboards

Dashboards are portals that view a specific persistence of data at a particular instant. For data-rich areas like sales, dashboards may feel deceptively simple; they provide a visual summary and direct interactions to help the viewer draw better insights from the raw data. Domain experts, like sales executives, are primarily interested in looking at data to understand how metrics are evolving. In short, dashboards help visualize query results.

Dashboards can take several forms and serve many purposes. They may just visualize the result of one or several single queries, in the case of micro dashboards, other times take the shape of a portal, a collection of specialized but related micro dashboards to monitor a specific data set, often across many distributions at once. This is the case for sales dashboards monitoring internal management goals, or even company portals, a macro dashboard summarizing a collection of corporate micro dashboards. Thus dashboards can serve a monitoring function; alternatively, dashboards can just aid a specific analytical quest which is, due to the size and diversity of the data, best suited to sensitize the user's examination of the pending queries she may decide to run. These dashboards for exploration help grab the general analytical tendency, and then a well-pursued examination decomposes the objective queries which will help the decision-maker reach a specific conclusion.

The above paragraphs illustrate the possible dashboard content. From these examples, we can derive a source- and uses-oriented classification of interactive dashboards. In terms of data source dynamics, dashboards may be static or dynamic. In terms of proposed interaction means, dashboards may be fully interactive, semi-interactive, or just informative, and in terms of the discussed data type, we can distinguish data-monitoring dashboards from data-exploration dashboards. Please note that exploration dashboards are somewhat different from business intelligence dashboards.

8.3.2. Benefits of Interactive Dashboards

Interactive dashboards are great tools for answering questions with data, often allowing the user to explore key aggregates while simultaneously exploring across the data cut by dimensions such as geography, demography, product category, etc. Users can simply hover over portions of reports of interest on demand to find out more detail or drill down further as needed. Queries are often ad hoc, posed and answered dynamically, and require little formal knowledge of analytics or coding from the end user. Dashboards

simplify the approach to BI without compromising any of the power or flexibility of enterprise analytic tools. Unlike static dashboards created in BI tools, for example, these dashboards are created interactively in analytics systems using user self-service.

Another powerful attribute of interactive dashboards in analytic systems is the ability for these tools to infer model requirements automatically, based on inputs from the user, utilizing subtle inference processes. This allows the business user to use advanced analytic techniques they would not be able to master without formal analytic training. The visual nature of dashboards also allows users to intuit results much more easily compared to using a set of tables or reports. These are actual visualizations and familiar templates, not just specifications indicating how a visualization should look. Finally, things such as alerts, advanced discovery and prediction, and even collaboration functions are embedded within the dashboards, making them even more useful as a complete analytic center for the user.

8.4. Data Sources for Sales Analytics

Access to data is key for enterprise sales analytics. Sometimes, data is too difficult to access, and when sophistication needs arise, alternative, less efficient but more powerful processes are valid approaches for conducting sales. Accessing available data should be part of any project goal.

Data could come from different sources and these sources, more or less accessible, are critical to the business intelligence project feasibility. Internal sources generally contain transactional, competitively advantageous data, while external sources may provide complementary data, together helping to better understand sales phenomena. Finally, techniques for data integration allow one to use multiple sources either at the same time or consecutively.

Integrated internal/external data help empower sales insight. Such various sources have different resource costs. In general, when internal data are exhaustive and good quality, external data serve as a complement, being less used. Bigger problems arise when external data either do not exist at all or are too simplified, or when internal data quality or covering are much reduced. Hence, it is important to conduct investigations in order to detect which source of data is most suitable towards producing applicable models. We discuss each of these data sources in the following and conclude this section with comments on data integration processes.

When discussing internal data, we are considering data that is usually found in the transaction database—part of the data warehouse—and other internal databases, possible data buckets, and file systems. In general, we expect to find good quality data about

transactions, because they are critical to business and by the enforcement of data entry procedures, cataloging, and storing is usually available.

8.4.1. Internal Data Sources

In general, there are two primary sources of data for sales analytics: internal data sources, which include any data collected during the sales process from sales tools and sales support software applications; and external data sources, such as marketing databases or third-party providers that furnish demographic information about individuals. We now consider each category in turn, focusing on internal data sources.

Any analytics tool has to address a business need, and sales analytics are no different. Thus, when considering creating any analytics tool for a sales department, we need to carefully consider what internal data we have and how we can supplement with external data (if necessary). We also have to assess how reliable these data are and whether they address the needs of the business. In particular, the issue of data reliability comes to the fore with regard to the completion of sales mandates and objectives. If salespeople write in their mandate that they went to visit a prospective customer because he or she bought a computer from the bank for a huge loan, then it does not mean that this is the reason why they made the sale and indeed, they may have added the note simply so that it would not look strange that they would have a private appointment with a prospective customer for a loan.

Internal data sources are data collected during the sales process, typically from a sales tool or sales support software application. Major internal data sources for sales analytics tools include databases from sales transaction systems, marketing promotion systems, customer service systems, claims systems, and so on. These internal data are the most reliable data sources available, are the easiest to obtain, and are the cheapest to implement.

8.4.2. External Data Sources

In making data-driven decisions, how can we know whether our data is lying to us, or what the story behind the data is? One of the details to check is whether we have the full picture, or only a partial picture. The most famous example in sales is a company that posted an annual 400% growth in gains from its real estate advertising business. While this number is indeed phenomenal, it is revealed to be both unsurprising and limited in relevancy by the fact that it attained these incredible growth rates after initially being such a small player. What is missing in the story is the backdrop of the complete market for real estate advertising for the area, especially competitors. This backdrop would

allow us to judge whether the rapid growth rate would meaningfully affect the direction, strategy, etc., of real estate advertising companies and agencies in general.

The best way to get a relevant backdrop is with market research. However, in our data-driven world today, there exists a plethora of amazing amounts of easily obtainable data, including from the government. A pertinent question for sales analytics, then, is: What type of external data should we be gathering? In this chapter, we will discuss the options available using Census data as the structure, since it's the best available government data source. In particular, we will address the types of external data sources available beyond Census data, how it relates to the topic of sales analytics, and applications of the external data in the sales analytics context. In particular, we will discuss consumer and business information sources, digital and relevant news sources, and consumer-occurrence information sources. While the focus will be on external data sources, we also address some specific internal data type questions, and how they fit into the overall, overarching discussion.

8.4.3. Data Integration Techniques

After discussing potential internal and external data sources that can be tapped into for the purpose of gaining deeper insight into sales performance, the next worthy question to answer is how to bring the data together in a meaningful way. Several methods of integrating diverse streams of sales relevant data exist, and the following presents a few of the more commonly used data integration methodologies.

Data integration at its most simplistic can be achieved through normalization; that is, shipping out raw data from either the primary sales information system or other ad hoc data repositories and then loading into the primary data source the relevant data fields from other repository. This process is aggravated when multiple repositories exist that each contain only segments of the relevant additional data fields. It is not uncommon to export raw lead dataset from a marketing automation system and combine that with close date and other relevant opportunity-level data fields loaded from the CRM, for subsequent preparation for upload into a sales analytics tool.

Integration of non-traditional data streams is also on the rise. For example, in the cases where non-office professionals travel long distances, pre-planned between client visits, it's likely that the company's expenses in terms of reimbursable travel shall be of significance. Expense reports, which contain travel data – hotels, airfare, meals, car rentals, etc. – for individual clients, including dates, may also enhance whatever sales information dwells in the CRM or ERP. In fact, with recent implementations of the Payment Services Directive in Europe, companies with a no-fee expense management system may be able to link to a common expense data repository, and combine that

dataset with customer, management, and sales revenue data for postmortem analysis of big ticket client sales events as a value-added service.

8.5. Designing Effective Dashboards

Most of the BI deployment successes that we have experienced so far have one common characteristic: effective dashboards. Dashboards are UI tools that make it easy to access key, actionable metrics, and they should be designed to display no more than 10 to 15 KPIs. Dashboards should deliver the facts that everyone can agree on. They should also allow for a quick refresh so that numbers are always recent. An ideal dashboard would actually give data at a specific point of view and offer insight into outliers or extreme variations, with a suggested reason for it. Publicly or privately shared, dashboards allow others to view those same facts and then ask questions and request further exploration.

A sales management dashboard will typically feature a variety of performance measures that are of interest to a sales manager at their level in the respective company hierarchy. Some of the most common to include are sales forecast, margin contribution or relative margin volume, actual vs. quota achievement, call or activity levels reported vs. expected activity levels for accountability, sales activity effectiveness to quota achievement, sales cycle summary analysis by winners and losers, months of pipeline coverage, product mix performance vs. target, and lost-order analysis. Dashboards are probably the easiest and most effective visuals that can be created, and with today's software tools, it is relatively easy to enable the user to manipulate what goes into them.

To be of value, a dashboard display needs to do more than inform. It should call attention to what is happening and what it means so that the user will recognize and act on significant changes and not necessarily those suggested primarily by the data. It will not be enough to just have lots of samples available to choose from. The user will need to make decisions on the type of graphic to use for the specific data function they want to convey. Having access to easily understood patterns and having tutorials built into the solution will be very helpful to users.

8.5.1. User-Centric Design Principles

Good design for business analytics dashboards often follows principles from the field of user-centered design, surveying ideas related to usability and usefulness. Importance is placed on minimizing aesthetic misattribution, information overload, and cognitive fixation; maximizing privacy and ethical considerations. Special attention is paid to color selection and placement when designing the interface layout. While these are general design principles for any type of analytical application, certain recommendations are

particularly relevant for constructing dashboards. A major role for a dashboard is to summarize significant critical indicators of business performance, which implies importance of the chosen indicators and how they are displayed. This is so dashboard users are afforded a means to assess business operations at a glance, such that action, if needed is quick and easy. Nevertheless, there are also contradictory design principles for dashboards; this introduces challenges for the designer. For instance, due to information overload, the general advice is to focus on displaying only a few important metrics at a time. However, on the other hand, dashboards can become valued as a feature-rich retrospective reporting tool used often by analysts, who desire to see many relevant performance indicators. What metrics are to be displayed on the dashboard varies across domains, business uses, and user needs; this is one of the more important components of the successful design worthy of additional attention throughout the dashboard construction process.

8.5.2. Visualizing Data for Clarity

Data is often messy and displays a multitude of chart types and a variety of representations. The following principles are valuable guides for designing effective information displays. Choose colors and shapes carefully: muted gray and monochrome color schemes highlight structure in data while overemphasized colors will confuse any reader - so choose patterns and colors that minimize interference with perception. Do not over-axonometric the display. If the distortion is minimized, reducing dimensionality can help viewers perceive more structure, especially with a focus + context display. Qualitative data with few values is ideally suited to pie charts, stacked bar charts, or simple point maps. Bar graphs are especially effective if the ordinal variables to be represented are matched with a memorable ordering. Choose axis intervals appropriately. In general, people perceive changes more accurately in linear rather than log-scaled graphs and log scaling also confuses many viewers. Additionally, choosing an appropriate tic interval is important. Minimize cherry-picking and clarify omissions. Consider using separate displays or guard/hedge judiciously when comparing two or more values on the same display. Unless intervals communicate uncertainty clearly, compare values from completely different intervals with care. Separate scales are dangerous: if possible, use a ratio or proportion between the values or a third reference variable to achieve a ratio. Avoid clutter and sparkle in your graphic: use reduction to avoid clutter, as needed and show data and details, at an appropriate scale for your question. Do not misrepresent information. Charts can lie easily through misrepresentations for emphasizing differences but can dispose powerfully viewers to think differently + better.

8.5.3. Choosing the Right Metrics to Display

To create effective dashboards, it is important to carefully select which metrics to display and how to represent them. Dashboards should focus on the most relevant, high-level KPIs that align with the dashboard user's goals. Users should see how they are progressing towards key targets, rather than have to offer analysis to judge their success. Performance metrics reported in the dashboard should be timely, allowing the user to take corrective action if lags or problems occur. Additional metrics at the bottom of the dashboard or when drilled into should offer more detail if a leading indicator displays a troubling change.

The best-known and most versatile approach for selecting the metrics to place in a dashboard is the balanced scorecard approach. It is advised to develop a map of the firm's strategy that has the goal of improving value to shareholders at the top. Beneath this annual goal, four major areas should have KPIs that are at least indirectly related to moving that KPI: financial performance, customer relationships, internal business processes, and employee growth and innovation. Strategically relevant metrics developed using the balanced scorecard approach give customers an idea of important issues that might not be reflected in current financial performance metrics but do bring managers back to the company's strategy. Using decision support or business intelligence tools also allows companies to analyze the relationships between lower-level metrics in more detail.

8.6. Tools and Technologies for Dashboard Development

The technology sector has developed a wealth of development tools designed to address certain dashboard development problems. Applying these tools can greatly reduce the amount of time and effort required to build an interactive dashboard or simple analytics tool. This section reviews several of the more popular options available, looking at dedicated dashboard and reporting tools as well as programming frameworks for building custom solutions. Understanding the possibilities and limitations of each will help organizations make informed decisions about the best approach for their specific needs. Although the primary audience for this chapter is business professionals and analysts that will be responsible for setting the requirements and making decisions regarding dashboard development projects, technical readers will also find value as there are often trade-offs between solution options that need to be weighed in making a technology selection.

Many organizations have taken the easiest route to dashboard development by using a specialized tool that focuses on providing visual dashboards and reporting capabilities. Some of the more popular options are with many enterprises already invested in one of

these solutions. These tools allow end-users to do much of the work of dashboard creation, connecting directly to data sources and allowing interactive design of charts, controls, and layouts. Popular features include drag-and-drop chart design, built-in libraries of chart types, and support for web-based distribution, often at low to no additional cost. This end-user-centric approach to dashboard creation allows the dashboard application to be easily tailored to unique business needs – though it does also run some risk of violating the fundamental principle of dashboard utility being based on careful dashboard design and oversight.

8.6.1. Popular Dashboard Tools

Dashboard solutions for easy development querying and geolocation visualization are embedded in many platforms. This includes Business Intelligence solutions, cloud Platforms as a Service solutions, and client oriented SaaS solutions.

Business Intelligence solutions were originally designed for Business Analytics. They can now easily connect to a large variety of structured and unstructured data sources and deploy user-friendly dashboarding solutions. Limited support for geolocation visualization tools and speed are the main limiting factors to their use in Sales Operations and other Business areas using large volumes of geospatial data.

Cloud Platforms as a Service are more recent SaaS solutions, designed originally to run on cloud servers. They integrate easily with the other modules of a Sales Analytics infrastructure working on cloud storage and computing. They also include building block APIs and are thus well positioned for the future of automated Adaptive Data-driven Decision Systems.

Finally, client oriented SaaS dashboard solutions have become a very popular way to develop fast solutions that display and explain a limited number of Interactive Dashboards. Integration with other client solutions typically limits the number of dashboards that can be developed with these tools.

8.6.2. Programming Languages for Custom Solutions

Custom solutions can be created using a variety of programming languages. The choice depends on the specific use case, the skills of the development teams, and company culture. The key musts are to choose a language that has a proper library ecosystem to support the rapid development of the required functionality and a good host framework. As both factors can change over time, this advice may need to be adjusted for a big

project planned for multiple years. Domain-Specific Languages should also be considered when solving specialized problems.

Python shines in fast development cycles, being both easy to learn and having an enormous library ecosystem. But it was never intended to be used in web page execution for security reasons. The fastest way to use it to serve web pages is to use one of the existing frameworks. The preferred way is to develop inside modern web frameworks that mix the client and the server side. The framework has support for publishing of graphs with Python.

Java has a long history of being one of the favorite languages for enterprise application development, and when looking for web page execution, it is usually built with JSP/Servlets. It was never the fastest language for development, but it is also not the slowest. It is strongly typed, and its design promotes solving problems with objects, which is helpful for code maintainability for complex projects. JavaScript is the natural language of the web, enabling a rich client-side user interface experience, and can be run on the server side as well. Its downsides are the development speed and code maintainability for larger projects. A language was developed to alleviate these problems and is being adopted by various enterprises, supported by good frameworks.

8.6.3. Cloud vs On-Premise Solutions

Cloud-enabled or Software as a Service solutions are web-based applications that facilitate the creation and sharing of business dashboards, while clients interact with dashboards using web browsers. Private cloud solutions that are hosted on an organization's infrastructure for the exclusive use of a single organization are also common. On-premise or on-site solutions, on the other hand, involve the installation of software applications on clients' web and/or local servers for local use. Although the majority of these applications today have the capability of being accessed via the internet, they are not completely cloud-enabled solutions. For the purpose of this text, we will refer to cloud solutions, whether they are hosted in public clouds or protected private clouds strictly for the use of one organization, as SaaS solutions.

Some of the most significant advantages of SaaS solutions include lower cost, ease of access, little or no learning curve, and rapid deployment. The user or usage-based model enables organizations with a variety of budgets to use these solutions, and their pricing models are refreshingly predictable. Ease of access is enabled both when these applications are being developed, as well as after contributing dashboards are deployed and shared with business stakeholders. IT departments should not be involved in such activities for the majority of these applications, as they are intuitive, while creating

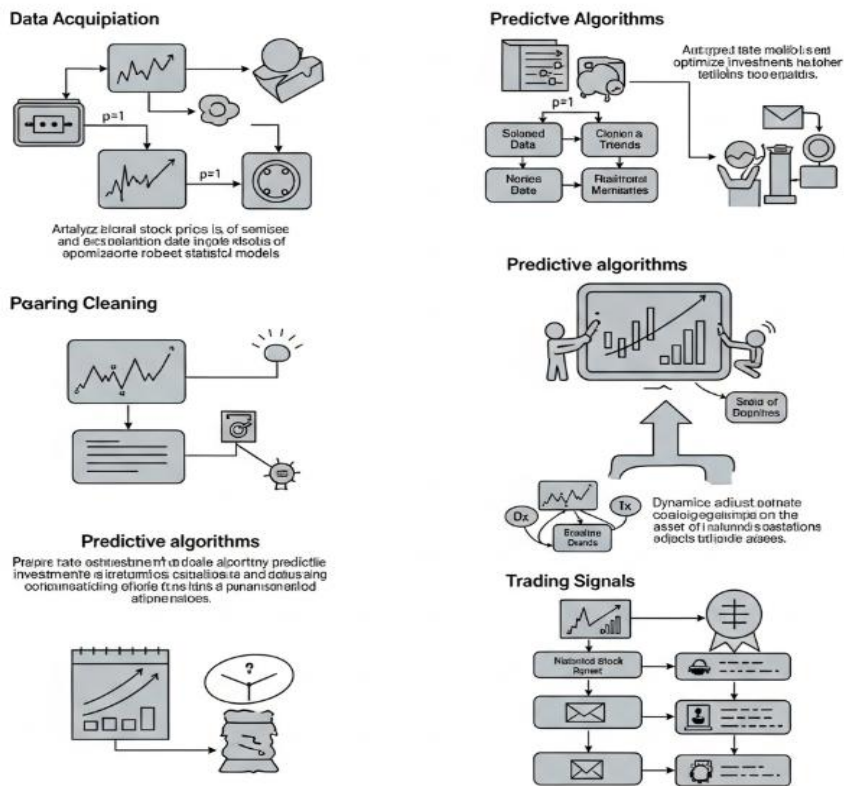dashboards in business terms is now possible for a variety of personas who are domain experts.

Fig 8.2: Effective Portfolio Management Using AI: Strategies

On-premise applications tend to be deeper in analytical power, provide better data integration capabilities, help with custom development or IT support in general, and enable organizations to have total control of their data and configurations. On-premise installations can be custom programmed to fit any type of configuration and can be leveraged during large-scale innovative technology shifts or disruptions. Governmental organizations may also be partial to on-premise installations due to their privacy and security requirements regarding data sharing.

8.7. Implementing Forecasting Techniques

Forecasting techniques project of sales and profits for the future. Such projections may help lower inventory levels and expenses, as well increase sales and overall profits. Managing the sales function would certainly be easier if an accurate sales forecast were available. Yet such forecasts are difficult to construct. Several forecasting models have

been developed over the years based on historical data or staff input, or a combination of both, to aid in the preparation of accurate sales forecasts. Many computer software packages are available to assist managers in preparing such forecasts.

Sales forecasting is the act of estimating future sales. Future sales predictions are one of the key elements of a company's budget. Since sales forecasts are an integral part of the budget, budgets are often produced only once a year. Short-term sales forecasting and long-term sales forecasting are the two types of forecasting. Methods and tools used for forecasting include budget variance analysis, sales force estimation and historical data analysis.

Sales forecasting relies heavily on historical data analysis. Since sales data is usually among the most reliable data in any organization, historical sales data is frequently used to project future sales levels. Predictions based on historical sales data may also be used as a guide for salespeople to assign sales quotas for the coming budgeting period. To get accurate sales forecasts, the integrity of the historical sales data must be established. All sales invoices must be accounted for. The company must also understand the basis on which past sales have been made.

8.7.1. Overview of Sales Forecasting

To achieve sales forecast accuracy, organizations usually attempt to measure the deviations between these forecasts and actual observable sales activity by analyzing errors. These forecasts are also used for measuring the capacity of salespeople to predict performance. In practice, one would normally find that sales forecasts are mostly projections of management judgment or intuition, rather than results of statistical models. Truly predictive sales forecasting models are typically few and far between. The reasons for this dearth of reliable models for predicting and extrapolating future sales are varied.

At first glance, the measure of forecasting accuracy implies assigning achieved sales in a given future period to a forecasted sales in the same period. Such a symmetric definition is often expressed by the assumption that both the forecast and the corresponding realized amount are expected to be equal or indicate the same thing according to the period. This, in itself, seems logical: It is to be expected that both of them tend to some arbitrary number in the future. These subjective predictions of sales figures are also simultaneously subject to the faults and biases to which the expert forecast has been exposed. Objectivity is compromised and thus the assumption for testing the anticipated precision of a specific error measure becomes invalid. Unfortunately, such an independent test is difficult to conduct.

More often than not, the so-called forecasting error is not only regarded as a means of testing the performance of a forecasting model. Even if error tests may be impossible in practice, most of the forecasting models depend for their application on the principle that the prediction of temporal development is as precise as possible, at least for short and medium prediction horizons. This expectation is deeply rooted in the various error testing procedures, which were introduced and that have in a way become the de facto standard for the evaluation of different forecasting models.

8.7.2. Quantitative vs Qualitative Forecasting

In general, forecasting can be divided into two broad categories: quantitative forecasting, which uses historical data to forecast the future, and qualitative forecasting, which relies on judgment to make forecasts. Quantitative forecasting works best when a significant amount of stable historical data is present, while qualitative forecasting tries to capture a more comprehensive view when quantitative methods have no reliable historical data. Qualitative forecasting methods help explain the extraordinary social and economic factors that can influence the future when reliable quantitative methods are unavailable, while quantitative methods are more efficient than qualitative methods in that they can be used with relative ease on many series at the same time. Whether you are forecasting at the corporate, division, or product level, your estimates may have a significant impact on your company's operations and policies. Senior management will generally make long-term forecasts, while operational management will focus on short-term time periods. The level of sales forecasting will influence not only your company's policies but also those of its suppliers, vendors, and other associates. Of course, it goes without saying that every company wants an accurate sales forecast because it helps budgets be balanced and optimum inventories to be ensured. This is true whether the forecast is prepared using a quantitative or qualitative methodology, or a combination of both. Regardless of how it is done, every organization uses sales forecasts for various purposes but mostly to estimate sales, net profits, assets, inventory and accounts receivable, capital expenditures, and other accounts.

8.7.3. Using Historical Data for Forecasting

In most businesses, especially large ones, sales data can be quite extensive, even having a long history. If we have historically tracked our sales, we can use this data to try to predict future sales, hence using quantitative forecasting techniques. This is similar to attempting to predict the future course of a stock price based solely on the past values of the price. We now review some forecasting techniques based on available historical data.

A naive approach is merely to assume that the next month's (week's, quarter's) sales will equal the last month's (week's, quarter's) sales. We will call this approach the Naive Method. Certainly, this requires no additional computations. While there are more sophisticated methodologies that may produce an apparently better fit to the historical data, they are often more costly to compute. Even though the forecast produced by the naive methodology will be off by a constant amount, it is logic-driven by the assumption that no change in the environment will occur, allowing it to work quite well in the short term. Many will use this technique as a benchmark, trying to improve on it.

As another example of a simple method, we can calculate the average sales for certain months in the past and use that as the forecast for that month for the coming year or months in the next year until the values adjusted for seasonality can be computed. This method only works if we have enough data points for each month to presume that the average is a good representative of demand. Businesses that have longer sales cycles could use a similar technique to forecast their longer sales cycles.

8.8. Monitoring Team Productivity

One of the hard problems sales managers face is ensuring that their team is as productive as possible while not being overly intrusive and acting as a "hall monitor." A sales manager cannot look over an individual sales rep's shoulder all day to make sure they are entering as many qualified opportunities into the sales system as possible or making enough customer sales calls. In this chapter, we discuss several types of reports and dashboards that managers can use to monitor their team's productivity to gain insights regarding their activity level, effectiveness, and sales pipeline state. The key is to monitor team sales activities and results often enough so that when a performance anomaly is detected, it can be addressed while there is still time to correct the issue.

The best way to track team activity levels is by examining their entry rate into the sales system for marketing-qualified leads and the closures or sales activity in CRM for completed sales. In addition to marketing-qualified leads, sales reps need to enter newly-created sales opportunities that are not yet connected to an active sales cycle. Team process engagement metrics track both the frequency and timeliness of activity, which creates data for identifying team effectiveness. Frequent addition of marketing-qualified leads to the sales funnel is critical; this supports sufficient pipeline volume to allow team members to meet their revenue targets and closable volumes.

8.8.1. Defining Team Productivity Metrics

Building an effective and productive corporate sales team is a primary goal of many organizations. Yet from expectations and experience to actual support and resources, factors impacting productivity can vary tremendously across members of a single team. Even with clear organizational goals, alignment in daily activity isn't always evident. If you ask a business development rep what team productivity looks like, they'll likely describe the metrics they are most closely monitored against, including outreach-related metrics, such as calls sent, and meetings scheduled. If you ask the marketing team, they might have an entirely different perspective, warped towards pipeline volume, days to close a deal, or ROI of individual campaigns. Ask a sales manager, and you'll maybe get feedback around revenue generation.

There's no single metric to monitor that describes productivity. Creating a holistic understanding requires multi-faceted team monitoring. For sales leadership to bolster employee productivity, they first need to align with the different roles of each individual, their goals, and how success is measured. From here, senior executives can look for commonalities between individuals or teams with the most (and least) impactful results. Productivity metrics could be a composition of awareness, efficiency, effectiveness, and impact across various stages of the customer journey. These can include items such as quota attainment, returns on activity, throughput, cycle time, activity mix, target market coverage, and account plan currency for reps as well as revenue growth, ratio of sellers to revenue, and contribution margin for managers.

8.8.2. Tools for Tracking Productivity

Tracking team productivity is important because gains and losses in productivity translate into money. There is a wide variety of technology tools for tracking productivity in an easy and painless way, including email trackers, desktop time trackers, project management tools with time tracking features, and collaboration tools that track activity across integrated, business-critical apps. It is important to note that these tools are good for estimating productivity, not measuring it. Even the most ubiquitous of them, email, is not a precise measure of productivity. This is because answer times can vary greatly by day and task; a short reply can take no effort at all and can thus hardly be considered a measure of productivity on that day. To take a more quantitative approach, email trackers calculate how much time you spend emailing. The total of emails sent divided by your work time gives you an estimate of the productivity contributed by that activity. This method of estimating productivity can easily be extended to other tools and activities; time spent doing a task divided by your work time gives you an estimate of the productivity contributed by that task or tool. Nevertheless, great care should be taken in interpreting the numbers generated by such attempts at quantifying productivity.

These numbers can be helpful with identifying trends but should never be taken as a measure for making decisions about individual employees. Furthermore, you should select different tools if your goal is to estimate productivity for long periods across disparate tasks, especially creative work.

8.9. Case Studies of Successful Implementations

Some companies that have successfully implemented analytics tools and dashboards for sales management show how these tools can become critical components of the company's performance and dashboards for sales management. Company A decided to expand powers sales with dashboards. As all major companies do, its sales team had a quarterly review to discuss planning, results, and strategy. In the middle of the discussion, some salespeople discovered that the corporate statistics were inconsistent with their results. The statistics indicated that there were multiple times the sales reported by the individual salespeople in the conference room. Why would people contact the corporate headquarters if they could put together a deal with a salesperson directly?

While other salespeople wondered whether those leads were real, one critical look at the corporate lead generation system showed that the leads were real. More importantly, these salespeople saw the value that such lead generation could mean for them. They quickly recognized that if a sale was made in Long Island, an area that one of them was responsible for, the commission was to be divided equally between the local salesperson and the salesperson for company HQ in charge of making the deal happen. Whether the other salesperson in charge of that deal was in the local office or in corporate headquarters, both were getting credit.

The company saw an opportunity that such a closed loop could increase the number of deals being closed with a significant impact on the corporate bottom line. However, it needed to improve the communications and closings on leads generated by corporate. If the salespeople could see the leads from company HQ coming into their state and local areas and what was happening to those leads, the two sides would be forced into communicating with each other. The tools: simple dashboards that showed the list of leads, marketing interaction history, and sales process status for the leads coming to each area. The expected results: better coordination/communication and sales/resource productivity. Such data visualization dashboards have shown salespersons the leads from the corporate marketing system that were entering their areas in real time.

8.9.1. Company A: Boosting Sales with Dashboards

Company A is a 25-employee agency which, since its establishment in 1992, has specialized in customizing and installing software solutions based on PeopleSoft, most notably the PeopleTools, a toolset allowing clients to develop and maintain applications to support their business processes. Headquartered in Cincinnati, the firm works throughout the U.S., focusing on the operations of multiple locations. Business volume has increased steadily, and Company A realized some time ago that it could best meet client needs and expectations by providing superior, consistent service. Following a business restructuring about a month ago, however, a lack of communication on resource availability among business managers was resulting in delays in starting new projects, which deepened customer dissatisfaction.

To remedy the situation, the company decided to implement a dashboard capability, giving project managers and business managers visibility into the occupancy results of the other functions and into resource utilization-related objectives. The dashboards were intended to remedy the problem by enabling better management of consultants' time between billable projects for client companies and internal operations. There was an urgent need to implement the solution, since a number of key client projects were about to start. As the business manager in charge of implementing the solution described it, the dashboard solution aimed at driving the company's business by monitoring each operational department's objectives compliance on a daily basis to try and avoid situations leading to clients' not meeting their expectations. This was summarized as providing better quality, faster.

8.9.2. Company B: Enhancing Forecast Accuracy

Company B provides drugs and services aimed at relieving the impact of debilitating diseases, including multiple sclerosis, hepatitis, diabetes, and certain cancers. The company is an American research-based pharmaceutical company, the largest biopharmaceutical company in the world over. The new millennium brought important challenges to the organization; strong deflationary pressures forced the company to cut prices while costs were growing faster than inflation. In particular, competition from generic drugs became very intense and the company started to lose its competitive advantage in terms of quality and services.

The company was interested in improving the accuracy of its overall sales forecast, in order to meet its goals of high customer service level coupled with low inventory levels. Such a forecast drives the entire network dynamics and, in traditional practice, is based on aggregate sales at product family or, at the lower level, product level. The aggregate model assumes that all the stores will have the same demand pattern for the entire

company. Thus, the forecast is based on the average demand pattern over all the stores, but this is not the most appropriate way to evaluate the demand, because the stores are very different from each other.

Different stores may have special events which are very unique and highly volatile and which are not captured by the aggregate forecast. Our idea was to estimate model parameters on a store-specific basis, while retaining the ability to share information across the entire store population. Moreover, cost and efficacy of customer promotion influence the forecasting problem but they are usually not included in the forecasting base. The novelty proposed is that promotion factors are included in the forecasting process. We decided to use a Bayesian formulation for three reasons: its capability to treat store-specific parameters, its greater flexibility and its specific features for influence factors.

8.9.3. Company C: Improving Team Productivity

An additional zone of business productivity enhancement resulted from discussions with a company that provides professional marketing outsourcing services for national and multinational customers, whose own development departments lack the time or conditions to execute all the necessary actions. This relatively small-size company specializes in promoting online products to large audiences. The company has a team of developers, graphic designers, marketing analysts, and quality analysts that can be configured depending on a particular project's needs. The CEO expressed a frequent frustration with guesswork in preliminary planning and time-intensive efforts in marketing campaign execution, especially within a very small budget of about 20–25 percent of the needed investment.

Marketing campaign formulation includes multiple iterative discussions with the client, so delays not just vitally harm the project but hurt the company's prospects and negotiations with other customers. Even simple brochure-like reports containing no more than a few logical tables are time-consuming to produce and finalize. Additionally, an excessive amount of e-mail messages complicates information exchange. Dashboards streamline the process. By keeping separate sections for each marketing channel, a dashboard with a few logical tables of simple marketing performance metrics for more than a year simplifies channel comparison and content finalization.

Of course, the company is not a researcher, and quality assurance and testing aren't their central tasks. However, they do have a suggestion at the end of one round and some experience implementing it. It also might happen that one idea will turn out the most promising among the others but will not be put into action because of a low confidence in its potential effectiveness. By offering the client a channel comparison dashlet, the

company will increase the probability of client suggestions resulting in probable revenue increase while also shortening the finalization cycle.

8.10. Challenges in Dashboard Development

Interactive dashboards and analytics tools for sales management are the primary end products of the effort described in this paper, which improves upon standard enterprise data warehouse capability. This end product is intended to provide the majority of ad hoc analytics needs for sales management users. Providing this functionality is important and expected to be very beneficial because it allows users to perform management research tasks that are very difficult, if not impossible, to execute in standard query-based tools, and it provides substantially more control and ease-of-use compared to the sales forecast workbooks prepared by the advanced analytics team. Despite the attractiveness and advantages of interactive dashboards from a visual and user experience perspective, they have not generally been used extensively by users, and we encountered several challenges in production dashboards that had been developed internally to projects. In this section, we review user adoption challenges in incorporating dashboards into analytics work streams, discuss data quality and data governance challenges we encountered in dashboards, and shed light on technical challenges in automating dashboard data extraction and submission to business intelligence tools.

Data quality has been a primary challenge for analytics. Business partners have expressed dissatisfaction with the accuracy of sales key performance indicators (KPIs) that have been developed in the effort, particularly for sales update monitoring. Many of the data quality issues recorded are multidimensional data issues, arising from the weekly nature of forecast submission and approval, and the fact that updates at different points in prior forecasts might not be aligned properly. Data patches at certain points in time might be very large and blunt, and detailed inspection by users has indicated situations where the flags do not correspond to actual forecast updates. Addressing these concerns while maintaining performance would be difficult, and until the predictive issues are addressed, users will likely view this dashboard as "only a better Excel file".

8.10.1. Data Quality Issues

Dashboards are designed to synthesize information from a variety of underlying databases. The users' experience depends on the integration of multiple data sources and how well they are cleansed and integrated within the dashboard. We have created dashboards that depend on data from as many as ten different databases with source tables containing millions of rows. Inquiries into these source systems often produce

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inaccurate output because of the absence of foreign key relationships, scrubbed records in a transactional system, or human error in data entry. The pre-eminence of data analytics has received attention recently, driving vendors to produce well-documented data governance and certification programs. Issues include the absence of timely data, problems with data integration from multiple systems, managing metadata, difficulties in data modeling where business processes change, uncertain data quality standards, missing or inaccurate master data, and duplicate records, and the need to manage or apply artificial intelligence solutions to big data.

The area of dirty data and its impact on prediction models has received a great deal of attention in the statistics and machine learning communities. These data often originate from several sources where data aggregation techniques have been utilized. All will agree that duplicate records in customer or transaction databases are a concern for dashboard developers. If the customer master record were to be used to derive average revenue per user by business line or product from the sum of revenues in transaction master file divided by the number of customers, any duplicate customer records would distort the graphical user interfaces.

8.10.2. User Adoption Challenges

User adoption challenges refer to the difficulties that may arise in getting users to actually use the dashboards and analytics tools that you create for them. After all, it doesn't matter how nice the dashboards are, or how complex the technology that
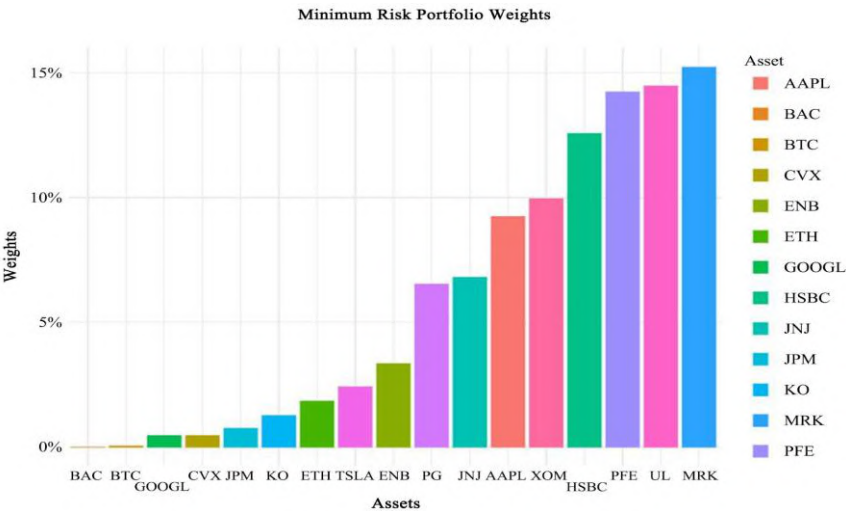

Fig : Hybrid Data-Driven and Deep Learning Based Portfolio Optimization

generates them, if the target users never use them! Sometimes dashboards may not be useful to users, and if that's the case, then no amount of dashboard appeal will entice users to use them. More insidiously, a dashboard that provides a limited amount of insight and is not aligned with user needs may still generate passable dashboards, and its periodic use will eventually be accepted as a routine, albeit reluctantly.

However, a dashboard that is infrequently updated because it's time-consuming to generate could elicit frustration and result in complete abandonment. Emotions run even higher when the intended users are management personnel, who have a choice of external consultants and service providers to produce detailed reports for them after they have made relevant information requests. If the choice of dashboarding is only made when it has become impossible to ignore the expense of an internal information infrastructure, the foray may be met with much skepticism. To reinstate dashboards in such a volatile environment, the dashboard developer must clear initial hurdles that ordinarily apply to newsletter or trend sheet editors, submitting proof-of-concept dashboards accompanied by assurances that what small gains have originally been made can be consolidated if both the choice of vague but informing indicators and the methods of automating the updates are approached with discipline.

8.10.3. Technical Limitations

Dashboards are generally focused on presenting static overview images using graphical elements such as charts and gauges, embedding predictive models presented in a static manner, and/or linking to other pages that explore data in other dimensions. User interaction typically goes as far as switching dashboard display refresh times or entering new time frames for reports, or, at best, dynamically adjusting slider parameters for the predictive models. Even if goals, metrics, structure, layout, and design of a dashboard are carefully selected together with end-users, user satisfaction might still remain limited by a dashboard's technical limitations.

The speed of the server and the network can restrict data output actions. Some of the potential limitations that would affect the performance of the dashboards, especially if there are a number of users accessing and placing demands on the system at the same time, are: Time needed to retrieve and upload the underlying data, time needed to process the needs of the requesting users; availability or consideration of multi-users or multitask sharing abilities; time needed to turn groups of data into graphic images; limitations on the size of stored and processed data. Some servers may support a very small data size, and apart from waiting for visualization refresh, the consumer may have to worry about sudden spikes. The organization may wish to consider restricted server access by only permitting certain people or roles to be allowed to upload data to the server, at least for some upload times.

8.11. Future Trends in Sales Analytics

Sales data analytics tools and dashboards are becoming an increasingly important proposition for most analytics platforms. A combination of established vendors and new startups is developing specialization in this area, offering solutions that incorporate key characteristics set out in this chapter with increasing effectiveness. This really is a market in which liquidity is driving growth, with established CRM vendors looking to embed dashboards and analytical tools within their applications, helping sell the users of CRM applications as potential customers. So, what should one expect to see from future sales analytics work? What are the trends in the development of sales dashboards and analytical tools? In this section, we outline some of the possibilities.

Sales analytics is an exciting and demanding field. Dynamic changes create new challenges for the development of dashboards and analytics tools, given the potential to create strategic competitive advantages for businesses taking advantage of these changes. The tools and techniques available to practitioners are also changing rapidly, with new techniques for text and social media analysis abilities on CRM vendors and new design frameworks available to developers. Future innovation efforts on analytical tools and dashboards for sales management tasks may be focused on the following areas. These developments are also exciting, definitely the investment of business or clinical time and resources to leverage them is modest when compared with the potential payoffs.

8.11.1. AI and Machine Learning in Sales

Sales departments already deal with considerable amounts of data from multiple platforms every day. Some advances in sales analytics, such as data modeling, visualizations, dashboards, and embedded analytics, are making data easier to digest and enabling analysts to obtain useful insights. While these aids do lessen some of the burdens, there are still many obstacles holding sales organizations back from being able to take full advantage of the data available to them. Sales and data analyst staffing levels are not able to keep up with maintaining foundations needed to make data easier to access or analyzing all of the data available. These bottlenecks are leaving companies missing out on opportunities, over-invested in problems, and underprepared for perils. Even with automation taking on some aspects of analysis, teams still need help.

Enter machine learning. Machine learning will allow sales organizations to overcome many of the common problems facing them today. Automated data preparation, cataloging, and profiling will give sales people and decision-makers access to the data they require without having to wait for an analyst to prepare it. Automated insights and explanation will surface likely items, both problems and opportunities, and assist the team in developing an understanding. Predictive recommendations combined with

intelligent workforce management will help sales teams prioritize deals on which to work. Advanced capabilities, like automated emotion detection, will make it possible for sales teams to select the proper representatives to close deals based upon complex factors.

8.11.2. Real-Time Data Processing

As more organizations recognize the importance of data in their sales initiatives, the sales analytics tools leverage a greater amount of data. Business intelligence and analytics were born from a desire to discuss particular business problems with empirical data, not just anecdotal evidence. As these tools grow up and facts grow larger, the size of the data being evaluated becomes a concern. The tools must be capable of processing significant amounts of detail in a reasonable time frame. With the associated large size of data comes a large problem, what do you do with that data? The most common answer is do something with real-time data processing.

The area of data processing has long had its own area of technical development, database management systems. With the rest of the technical world rushing along with more power, better performance, faster networks, smarter development tools, and the like, the database world has slowly consolidated into a small number of vendors executing hundreds of millions, if not even billions, of lines of code. It is a mature area of technical development, and it's mature around vendor support of technical resources, tuning, setting up, building models, and knowing how to ask the right questions of the data.

For the data analytics tools, we are emphasizing your sales operational data and sales customer interaction data. We want to talk about - what in the world do we do with multi terabyte data repositories? We have some answers aimed specifically at business users, not just developers. Sales enablement is about enabling sales reps and sales management with actionable insight. What does actionable insight mean? It means you want answers from your data, but we want those answers available to sales users without additional investment in data developer staff resources.

8.11.3. Predictive Analytics Advancements

Predictive Sales Analytics requires a solid understanding of what will happen in the future, based on the data put in by various stakeholders. Predictions must be relevant and timely, otherwise decisions might be taken late. Predictive sales analytics is a necessity in the market today; driven by the massive amount of data available and the increasing computational capabilities, the number of projects carried out in companies around the world has increased tremendously. However, predictive analytics is not an easy task!

The various players involved in the process often have a very different understanding of it. Not to mention the possibilities that exist nowadays to carry out predictive analytics that require no prior coding abilities.

Difficulties encountered are primarily centered on the interpretation of results. Prediction algorithms tend to give different results depending on the variables chosen and need to be understood to deliver robust results. Nevertheless, predictive sales analytics can be an incredible value for any organization. Organizations would be able to streamline their processes, increase sales and much more. Sales volumes could be forecasted with much more accuracy and the drivers of these sales could be understood in detail. These forecasts can also ensure that organizations look beyond the next week, calendar month or quarter and build a perspective that will ensure that their market strategies stay relevant throughout the year and not just in peak shopping periods.

8.12. Best Practices for Dashboard Maintenance

Interactive dashboards provide the best real-time insights into the internal and external factors affecting performance. However, dashboards don't just need to be created for them to work. Like any other business function, dashboards need to be maintained too. Here we share some key points to keep in mind to ensure that the dashboards are relevant, and drive continued performance. Dashboard management is not a one-time job. A dashboard needs to be updated and iterated upon frequently, especially in a dynamic service environment such as sales support. New parameters could become relevant. Others could become irrelevant. Most importantly, sales teams need to be provided with updates as and when important events happen. A dashboard that has stale information is worse than one that provides no information at all. Such a dashboard indicates either negligence or inexperience on the part of the manager. What you really don't want to do is to drive your sales team to square one by distracting them with irrelevant factors. Dashboards need to help push the sales team closer to their goals. Nothing else. User feedback is one of the most important factors to keep in mind during the maintenance of the dashboard system. Specific feedback can be gotten from surveys. Generalized feedback can be gotten during team meetings. Each sales team is unique. The parameters that drive their metrics are also unique to an extent. However, insights have their limitations in terms of percentage of efforts. Dashboards present a global view of the performance across teams. Detailed focus on aspects of performance are required only when the performance is along-expectations. Such checks cannot be implemented for every KPI and not during all time periods. Key reasons for performing a post calculation of the dashboard utility include missing important results, action item suggestions and modified goals. It will be helpful to include the sales team members in preparation of

some of the dashboards. This will not only help impart utility but also enhance ownership for the insights provided by the dashboards.

8.12.1. Regular Updates and Iterations

Dashboards and analytics tools become less useful over time if their content is static. Therefore, it is critical that dashboards and analytics tools are updated regularly to incorporate the most recent data. They should ideally enable a view of how key metrics are evolving over time. This could be accomplished in one of two ways. The most common option is to create periodic refreshes of the dashboard to reflect the latest data. Most solutions used for creating dashboards support this feature. The upper tier solutions can also automate the process of emailing a PDF version of the dashboard to a pre-defined list of users. The second option is to build fully interactive dashboards on top of a business intelligence solution. These enable sales team managers and executives to control the time parameters. They can pull out data for different custom periods, day of week, sales rep, profile of customers, and specific products or product categories, in real-time or near real-time.

It is also a good practice to periodically re-evaluate the effectiveness of dashboards and other sales analytics tools on their analytical requirements. For better, faster analysis of their data, users can often think of better, more refined solutions that enable them to get quicker access to business insights. Business challenges also change frequently, especially in the case of sales organizations. Therefore, the set of metrics that management is interested in keeping track of can also change over time. Creating and iterating an entire rep performance dashboard, for example, on a steady, daily/weekly basis can be exhaustive. It is also often not possible to forgo the entire rep performance cycle for a new or fresher view of rep performance. Therefore, it may be useful to break up the rep performance dashboard into smaller sections and put those up as independent dashboards. These could reflect aspects of performance like performance vs peers, performance vs goal, or call activity in an entire tab. Then, set plans for refreshing the dashboards at frequent intervals, say weekly, until the entire dashboard is done.

8.12.2. User Feedback Incorporation

Dashboards can often be the focal point in business discussions. They hold the guardrails for managing a business by pointing out the growth areas as well as the areas that need correction. Given their far-reaching implications on decision-making as well as strategy formulation, it is imperative to continuously assess their relevance and accuracy, by reviewing the calculations performed, through verified data sources, giving way to the final visuals. What these visuals capture could come from the business data, but could

also be compared with secondary sources that may point out trends around the primary source data.

An interactive dashboard is truly responsive to a user when the design captures the user's intention. The initial design may focus only on the primary goals of visual outputs that initially call for ogling. The maintenance stage of dashboard building not only entails the usual checking of data quality, but something more than just housekeeping. It means engaging the customer or the dashboard user in a way that the develop-build-groove cycle of dashboards is implemented. At a stage of regular or irregular updates, additional intent and future visualization goals may come to light. Dashboard users are constantly engaged in day-to-day decision-making processes, and request special changes or add-ons proactively or out of necessity. The development team must continuously listen to optimize the power of exploration-enabled interactivity, which can keep kicking up insights at a dashboard user's level. Other times users get tired of guessing the manipulate-the-visuals style of querying and wish for some preparatory data-driven suggestions to follow. Users are at times more adept as viewers than builders, but such wish can turn into a valuable request for clever analytic capabilities built into the dashboard.

8.13. Conclusion

In this paper, we presented our experiences in building various interactive dashboards and analytics systems for managing both sales executive performance and total sales management using web application technology. These systems validate and expand upon the traditional BI concept of dashboards for intuitive performance management of key people and processes outside of finance. Business intelligence systems for monitoring just corporate financials and product sales are too limited for managing present day corporations. Data users want to quickly access relevant information for analyzing why people and processes are doing what they are doing. In the applications we presented, dashboards facilitate interactive exploration of sales resources by geography, product, promo size/discount, and customer via dimensions not currently trivial with existing financial BI tools.

The data is collected from multiple applications such as enterprise resource planning and sales management/automation, expense application, customer relationship management, data warehouse, supply chain management systems, and spreadsheets. While the tools are specific for sales and marketing, they illustrate how multi-application data for other functional areas could be tailored for flextes for building other customized analytic dashboards across functional areas and for other data uses.ible multidimensional reporting customized for non-experts. There is nothing unusual about trying to get the best sales results, just as every functional area is trying to optimize performance. Why

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don't we invest in the best sales analytics tools to help executives do a better job managing? Given the still low fraction of budget that companies devote to analytics relative to the value generated from using analytics, the specific tools discussed should be viewed as templa

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