

# DATA VISUALIZATION FOR BUSINESS DECISION-MAKING: A DECISION-ORIENTED DASHBOARD FRAMEWORK

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**Abstract** - Organizations increasingly depend on sales, customer, financial and operational data, yet large volumes of raw data do not automatically produce better decisions. Data visualization and dashboard design can reduce the effort required to identify trends, compare categories, monitor targets and investigate relationships. This paper presents a literature-based conceptual study of dashboard-supported business decision making and proposes a compact decision-oriented framework that links a business question to relevant data, data preparation, visual selection, interpretation and business action. Common visual forms including key performance indicators, line charts, bar charts and scatter plots are mapped to representative business questions. An illustrative retail scenario is used only to demonstrate the framework; its numerical values are synthetic and are not presented as empirical evidence. The study also identifies practical risks including poor source data, misleading scales, outdated information, excessive visual complexity and unclear metric definitions. The central finding from the reviewed literature and conceptual analysis is that dashboard effectiveness depends less on the number of charts than on the fit between information quality, visual encoding, user needs and the decision context.

**Keywords:** Data Visualization, Business Intelligence, Dashboards, Decision Making, Business Analytics, Data-Driven Decision Making, Dashboard Design

## 1. INTRODUCTION

Modern organizations make decisions using information from sales systems, customer platforms, finance applications and other digital sources. As information grows, managers cannot inspect every row of a spreadsheet before acting. Visualization addresses this problem by presenting selected information through charts, tables, indicators and dashboards. A useful visualization is not merely attractive; it should help the user notice a trend, compare groups, identify an unusual value or understand a relationship. Research also indicates that visual design influences information processing and that poor presentation can increase the effort required to reach a decision [1], [2].

Dashboards are particularly useful because several related measures can be presented in one view. However,

additional information is not always beneficial. A dashboard containing too many charts, decorative elements or unrelated indicators can distract users from the primary business question [3]. Accordingly, dashboard design should begin with the decision that must be supported rather than with the choice of a fashionable chart.

This paper contributes a practical, decision-oriented framework that connects business questions with data preparation, chart selection, interpretation and action. It also organizes common dashboard views into a compact set of decision tasks and highlights data-quality and design conditions that can reduce dashboard usefulness. The work is conceptual and illustrative; it does not claim new survey, experimental or organizational performance results.

A useful dashboard should therefore be treated as a decision-support interface rather than simply as a collection of charts. The value of a visualization depends on whether the viewer can identify the relevant measure, understand its context, recognize an important change and connect that observation to an appropriate business response. For example, a decline in monthly revenue is only the beginning of an investigation; the manager may then need to examine product categories, regions, customer segments or profit margins to determine what action is justified. This sequence makes dashboard design closely connected with the way business questions are asked and answered.

## 2. OBJECTIVES AND RESEARCH QUESTIONS

(i) explain the role of visualization in business decision making; (ii) relate common chart types to practical business questions; (iii) present a compact dashboard framework linking data preparation to action; and (iv) identify design and data-quality issues that can reduce dashboard usefulness.

Research Questions: RQ1: How can common visualization types be mapped to practical business decision tasks? RQ2: How can a dashboard connect data preparation, visual selection, interpretation and business action? RQ3: Which data-quality and design issues can reduce the usefulness of a business dashboard?

### 3. LITERATURE REVIEW

Padilla et al. [1] present a cognitive framework for decision making with visualizations and distinguish between rapid visual judgments and slower, more deliberate reasoning. This distinction is relevant to business dashboards because a manager may first notice a change and then inspect the underlying values before deciding what action to take.

Eberhard [2] reviews research on visualization, judgment and decision making and reports that visualization can improve decision quality and speed, while outcomes also depend on user, task and cognitive factors. A practical implication is that the visual representation should match the analytical question: trends are typically supported by line charts, whereas category comparisons are often clearer with bars.

Hjelle et al. [4] experimentally studied dashboard visualizations with 524 participants and found that information format, currency and completeness can influence information satisfaction and perceived task complexity, which in turn relate to decision quality. This suggests that a technically correct dashboard can still be weak when its information is incomplete, outdated or difficult to interpret.

Dimara et al. [3] examined the unmet visualization needs of organizational decision makers and identified requirements extending beyond conventional analysis, including trade-off overviews, scenario-based analysis, interrogation, flexible data input and collaboration. Vila and Gomez [5] further showed that the framing and design of graphs can influence how viewers extract information. Together, these studies support a decision-oriented view of dashboard design.

Across these studies, a common theme is that visualization effectiveness depends on the relationship among data, task, user and presentation. A technically attractive chart may still be ineffective if it does not answer the manager's question or if the underlying measure is poorly defined. Conversely, a relatively simple chart can be highly useful when it makes the required comparison immediately visible. The literature therefore supports a task-oriented approach in which visual complexity is not treated as a goal in itself. The present study builds on this principle by organizing visualization choices around recurring business decisions such as monitoring performance, comparing categories, identifying trends and examining financial relationships.

### 4. RESEARCH GAP

Existing literature addresses visualization comprehension, dashboard usability and analytical techniques, but these elements are often discussed separately. For a business user, they are experienced as one decision process: identify

the question, obtain and prepare the relevant information, select an appropriate visual, interpret the evidence and determine an action. The practical gap addressed by this paper is therefore the lack of a compact practitioner-oriented framework that explicitly connects these stages. The proposed framework does not claim to replace established visualization theory; rather, it organizes established principles into a usable decision-support sequence.

### 5. METHODOLOGY

This study uses a conceptual literature-synthesis approach supported by an illustrative retail scenario. The literature was examined to identify recurring themes related to visualization, dashboards, information quality and business decision making. The study is not a systematic review and does not claim a statistically complete coverage of the literature. No primary survey, interview or controlled experiment was conducted.

The dashboard figures and charts are original illustrative examples prepared to demonstrate the proposed framework. Their values are synthetic and are included to explain layout, visual selection and interpretation; they must not be interpreted as actual company performance or as experimental findings. This distinction is important because the contribution of the paper is conceptual and design-oriented rather than empirical.

The study was developed in four practical stages. First, concepts from the selected literature were reviewed and grouped into themes such as visualization comprehension, dashboard design, decision support, data quality and user needs. Second, these themes were translated into a business workflow beginning with a decision question instead of beginning with a preferred chart type. Third, an illustrative retail scenario was used to demonstrate how the workflow operates across executive monitoring, trend analysis, category comparison and profitability analysis. Finally, the resulting framework was checked for conceptual consistency: each visualization was required to have a clear analytical purpose, an identifiable business question and a plausible decision or follow-up action. This process does not constitute empirical validation; it is a structured design approach for demonstrating how the concepts can be applied.

### 6. PROPOSED DECISION-ORIENTED FRAMEWORK

The proposed process is: business question → relevant data → cleaning and aggregation → suitable visual → interpretation → business action.

The framework begins with the decision need rather than the chart. For example, a question about change over time is better served by a line chart than by a pie chart, while a question about category ranking is better served by a bar

chart. Data preparation and validation precede visual encoding so that the dashboard does not amplify errors already present in the source data.



**Fig. 1: Proposed decision-oriented visualization framework.**

The framework can also be viewed as a feedback loop. A manager begins with a question, examines a summarized view, identifies an exception or pattern and then asks a more specific follow-up question. This means that a dashboard should support both overview and exploration. The first layer should answer questions such as 'Are we on track?' while the next layer should help answer 'Where is the problem?' and 'What may be causing it?' A well-designed dashboard can therefore reduce unnecessary movement between separate reports while still allowing the user to move from summary information to focused analysis.

## 7. CORPORATE-STYLE DASHBOARD

Corporate dashboards commonly place the most important indicators near the top and supporting analysis below them. The example used in this paper combines key performance indicators with a monthly sales view. The values are illustrative and are included only to demonstrate layout and interpretation. In an operational dashboard, selecting a month could filter the remaining visuals, allowing a manager to move from summary information to detailed analysis.



**Fig. 2: Illustrative executive sales dashboard with key performance indicators.**

The top indicators provide a rapid status check, while the line chart adds temporal context. This reflects a useful

design principle: summary information should be visible first, while supporting detail should remain available when the user needs to investigate an exception [4].

In addition to hierarchy, a corporate dashboard should maintain consistency in terminology, units and time periods. If one visual reports revenue in thousands while another reports it in millions, the user must perform an unnecessary mental conversion. Similarly, KPI definitions should remain stable across reports so that a change in a value reflects a real business change rather than a change in calculation. Filters should also be meaningful; adding many filters without a clear analytical purpose can increase complexity without improving understanding. The design objective is consequently not to maximize the number of available controls, but to provide the minimum interaction required to answer the most important management questions.

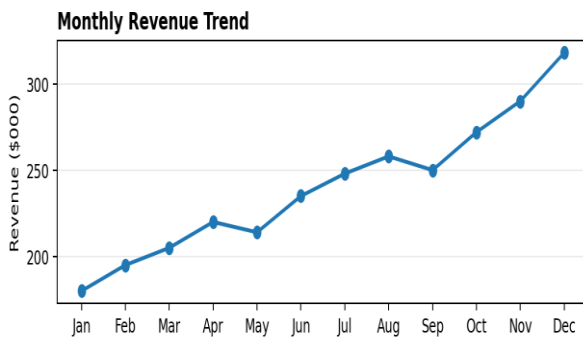
## 8. CHOOSING THE RIGHT CHART

| Business question               | Useful visual    | Reason                   |
|---------------------------------|------------------|--------------------------|
| How are sales changing?         | Line chart       | Shows movement over time |
| Which category sells more?      | Bar chart        | Easy comparison          |
| Are revenue and profit related? | Scatter plot     | Shows relationships      |
| Are we meeting a target?        | Actual vs target | Shows performance gap    |

Chart selection should follow the analytical task. Line charts are appropriate when the primary question concerns movement across an ordered time scale. Bar charts are useful for comparing discrete categories because differences in length are easy to inspect. Scatter plots are appropriate when the user wants to examine whether two quantitative variables move together, although a visible association should not automatically be interpreted as causation. Actual-versus-target displays are useful for monitoring performance against a predefined goal. The choice should also consider the amount of data, the expected reading order and the level of precision required. For a small executive dashboard, a simple visual with clear labels is generally preferable to a complex chart that requires extensive explanation.

## 9. ILLUSTRATIVE SALES TREND ANALYSIS

A line chart is useful when the manager wants to understand movement over time. Monthly sales can reveal growth, seasonal changes or sudden drops. The purpose of the chart is not to make a decision from one visual alone, but to identify patterns and exceptions that require further investigation.

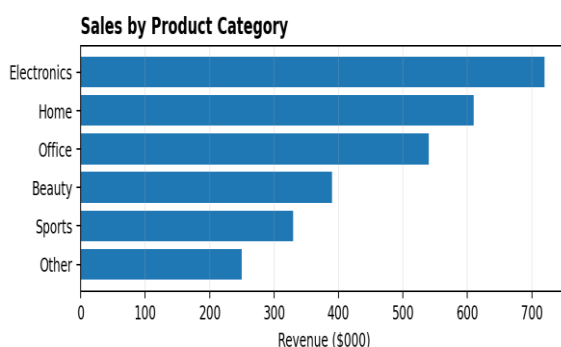


**Fig. 3: Illustrative monthly revenue trend.**

The time-series view can also be used as a starting point for exception analysis. If revenue changes sharply between two periods, the next step is not to assume a single cause but to decompose the change into relevant dimensions. A manager may compare product categories, sales channels, regions or customer groups. In a real dashboard, this can be implemented through controlled filtering or drill-down. The important design principle is that the second-level analysis should be connected to the first-level observation. This preserves a logical analytical path and helps prevent users from jumping between unrelated charts.

## 10. PRODUCT ANALYSIS

After identifying the overall trend, a manager may want to know where revenue is coming from. A category-level bar chart answers this question quickly because bar lengths support direct comparison. In a real dashboard, the view could be filtered by region, month, customer type or sales channel, allowing the manager to move from a broad observation to a specific question.



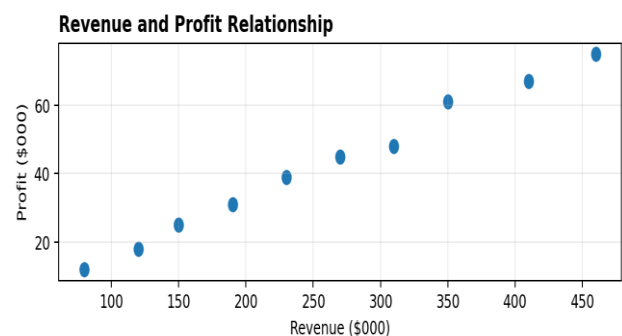
**Fig. 4: Illustrative revenue contribution by product category.**

In an operational dashboard, this category view could be filtered by region, month, customer type or sales channel. Such filtering allows a manager to move from a broad observation to a specific question, such as whether a strong category performs consistently across regions.

Category analysis provides another level of diagnostic information. A category with the highest revenue is not necessarily the category with the highest strategic value. Managers may also consider gross margin, inventory turnover, return rates, discounts and customer demand. A bar chart is therefore most useful when its measure is explicitly stated and when the categories are ordered in a way that supports comparison. If several measures are required, they should be introduced carefully rather than combined into an overloaded graphic. The dashboard can then act as an entry point to a more detailed analytical report when deeper investigation is required.

## 11. REVENUE VERSUS PROFIT

Revenue alone does not show whether an activity is financially attractive. Products with similar revenue can produce different profit because of pricing, discounts, shipping and other costs. A scatter plot can therefore help identify high-revenue, low-profit cases that deserve further investigation. The visualization indicates where attention may be needed; it does not establish causality.



**Fig. 5: Illustrative relationship between revenue and profit.**

The revenue-profit view illustrates why multiple measures should be interpreted together. High revenue can coexist with weak profit when costs or discounts are high, while a lower-revenue category may generate stronger profitability. A relationship chart can help users identify unusual cases that deserve investigation, such as products with high sales but comparatively low profit. In a real organization, such observations would need to be followed by additional analysis of costs, pricing, returns and other operational factors before any decision is made. The chart should therefore support questioning rather than replace managerial judgment.

## 12. DISCUSSION

The illustrative examples show that visualization can support business decisions in stages. KPI cards provide an initial status, line charts explain change, bar charts support comparison and scatter plots help examine relationships. Using several views is useful only when each visual

answers a distinct question. This supports the central proposition of the paper: dashboard quality is determined by decision relevance, not by the number of visual elements.

An important issue is cognitive load. Too many colors, decorative effects, small labels or unrelated indicators can make a dashboard harder to use. Research on dashboard decision making indicates that information quality and presentation affect the effort required from decision makers [2], [4]. A small set of purposeful visuals can therefore be more useful than a crowded page.

Trust is another issue. If a dashboard contains outdated data or unclear definitions, managers may act on a misleading picture. Measures such as revenue and profit should have consistent definitions and visible time periods, and data validation should occur before information reaches the decision maker. These considerations connect visualization design with the broader issue of information quality.

From a managerial perspective, the framework encourages a distinction between monitoring and diagnosis. Monitoring requires a compact set of indicators that can quickly show whether performance is within an expected range. Diagnosis requires more detailed comparisons that help explain why a change occurred. Combining both purposes on one screen can be useful, but they should remain visually distinct. For example, KPI cards can provide status information at the top, while trend and category views provide supporting evidence below. This separation reduces the risk that secondary analytical details will compete with the primary business message.

### 13. PRACTICAL GUIDELINES

A business dashboard should start with the decision, keep the number of primary visuals small, use consistent units, label charts clearly, avoid unnecessary decoration, show the time period, highlight exceptions and provide a path from summary information to detailed analysis. Where possible, metric definitions, refresh timestamps and filters should be visible so users can judge whether the information is current and comparable.

Another practical consideration is accessibility and communication. Dashboard users may view reports on different screen sizes, during meetings or through exported documents. Small labels, low-contrast elements, excessive annotation or dependence on color alone can reduce readability. Clear titles, direct labels and consistent notation improve the portability of the analysis. It is also useful to document data definitions and refresh frequency so that users understand what a number represents and how current it is. These practices strengthen trust because the dashboard communicates not only a value, but also enough context to interpret that value responsibly.

### 14. CHALLENGES AND LIMITATIONS

Visualization cannot fix poor source data. Missing values, duplicate records and inconsistent categories can create a false sense of accuracy. Different managers also need different information, so dashboard design should consider the user's role, task and decision context.

This paper is limited by its conceptual and illustrative nature. The charts use demonstration values and are not evidence from a real organization. The literature synthesis is not systematic, and no primary user study was conducted. Future work should evaluate the framework using real company data and controlled user studies that compare decision time, decision accuracy, information satisfaction and user experience across alternative dashboard designs.

Future research can extend this conceptual framework through empirical evaluation in real organizational settings. Possible studies could compare different dashboard layouts with controlled user tasks, measure decision time and accuracy, or examine how users respond to alternative visual encodings. Case studies could also investigate how dashboard adoption changes across managerial levels and industries. Such work would provide evidence for determining which elements of the proposed framework have the strongest effect on decision quality. Until such validation is conducted, the framework should be interpreted as a practical design model rather than as a claim of measured organizational performance.

### 15. CONCLUSION

Data visualization can help businesses move from large collections of numbers to information that can be reviewed quickly and acted upon. The main lesson of this conceptual study is that effective visualization is not simply about choosing attractive charts. The visual must match the business question, present reliable information and help the user move toward an appropriate action.

For routine management work, a compact dashboard containing KPIs, a time trend, a category comparison and a relationship view can provide a useful starting point. More advanced features such as filtering and drill-down should be added when they serve a clear decision need. The proposed framework provides a practical sequence from business question to action while recognizing that visualization quality depends on data quality, user context and information clarity.

### ACKNOWLEDGEMENT

The authors sincerely thank Dr. Pranjali Patil, Assistant Professor, D. Y. Patil Deemed to be University, School of Humanities & Sciences, for her guidance, academic

support, and valuable suggestions throughout this research work.

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