Data Warehousing and Business Intelligence
(Business Intelligence)

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NIBM POWERING GREAT MINDS

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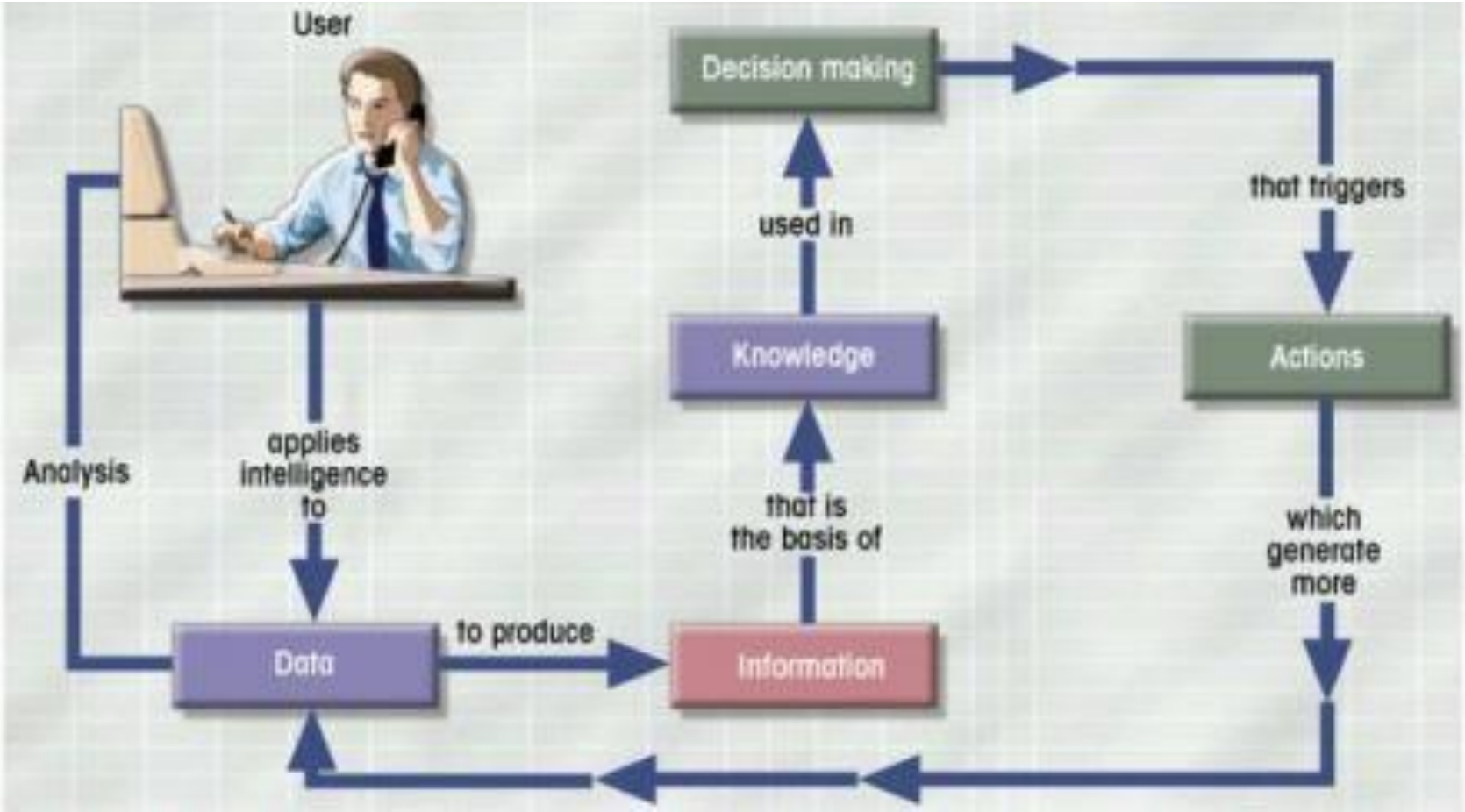
Outline

- Business Intelligence
- What is business intelligence?
- Business intelligence process
- Data Visualization
- Types of data visualizations
- Ways of presenting data
- Operational and analytical reports, dashboards, scorecards, self-service BI
- Well-known visualization features
- Challenges in visualizations

Business Intelligence

Data-Information-Decision Cycle



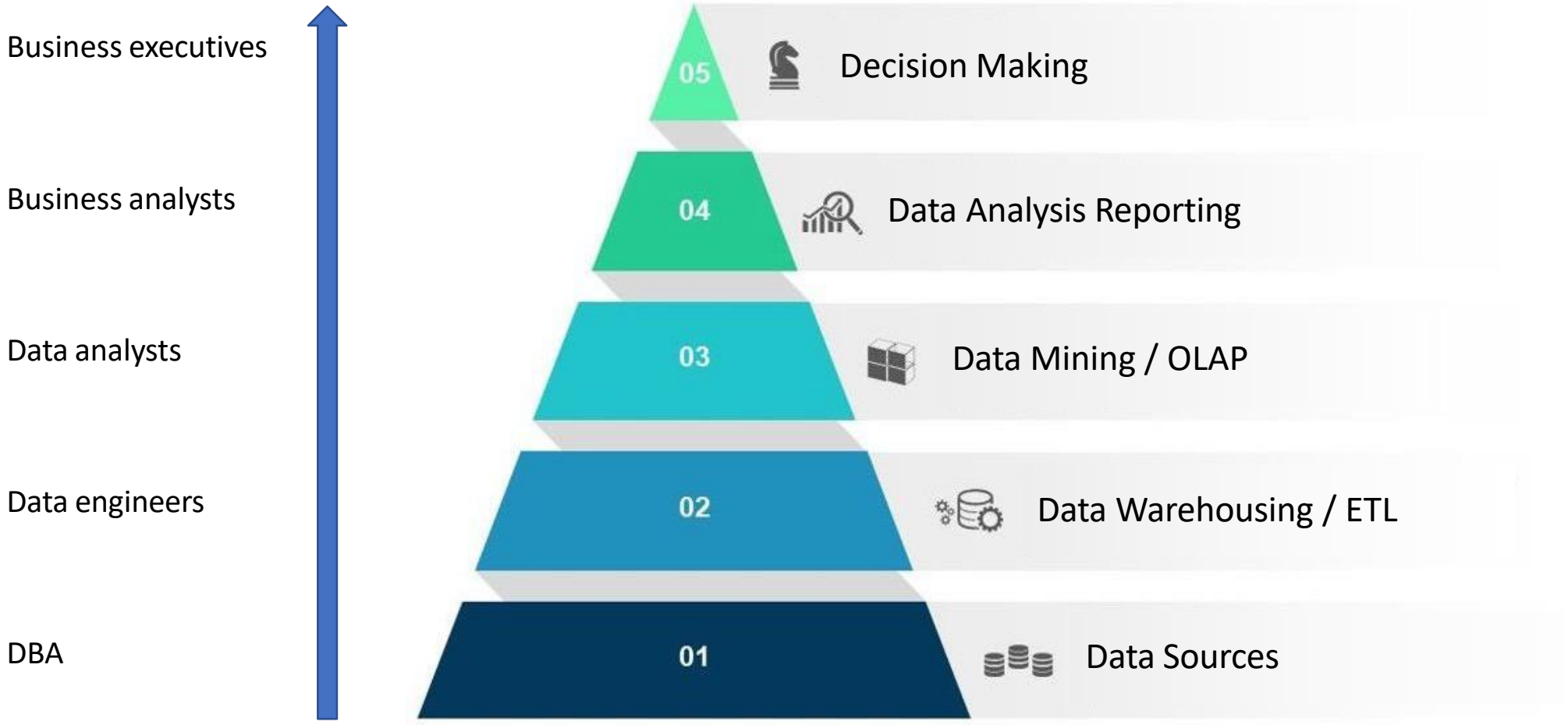
Decision Making

- Decision making at different levels
  - Operational
    - Related to daily activities with short-term effects
    - Structured decisions taken by lower management
  - Tactical
    - Semi-structured decisions taken by middle management
  - Strategic
    - Long-term effects
    - Unstructured decisions taken by top management
- Decision making steps:
  - Problem identification
  - Finding alternative solutions
  - Making a choice

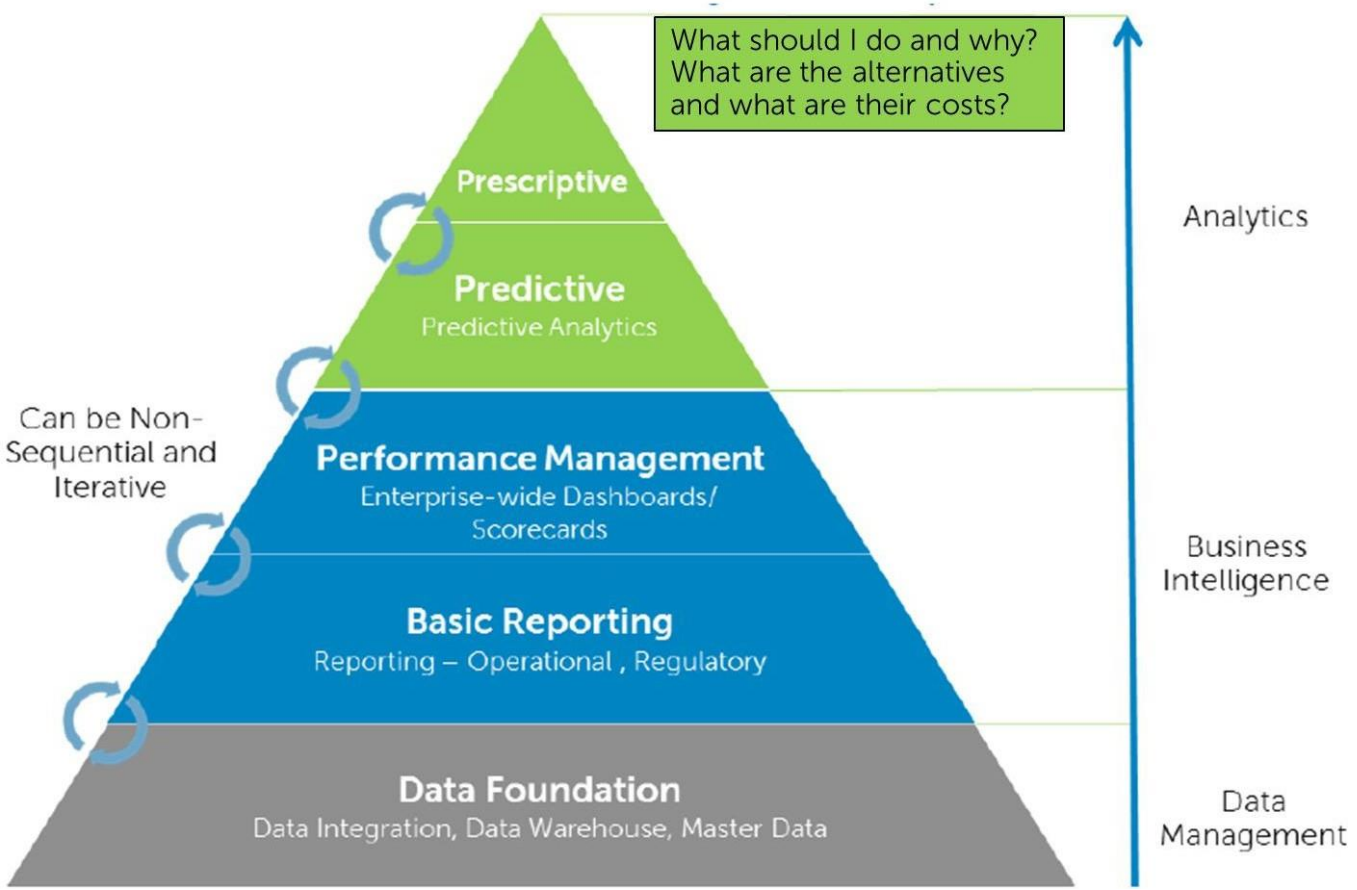
What is Business Intelligence?

- BI leverages software and services to transform data into actionable insights, used for organization’s strategic and tactical business decisions
  - BI tools access and analyse data sets and present analytical findings in reports, summaries, dashboards, graphs, charts and maps to provide users with detailed intelligence about the state of the business
- The term business intelligence often also refers to a range of tools that provide quick, easy-to-digest access to insights about an organization's current state, based on available data
- New trends in BI includes AI, collaborative BI, embedded BI, cloud analytics.

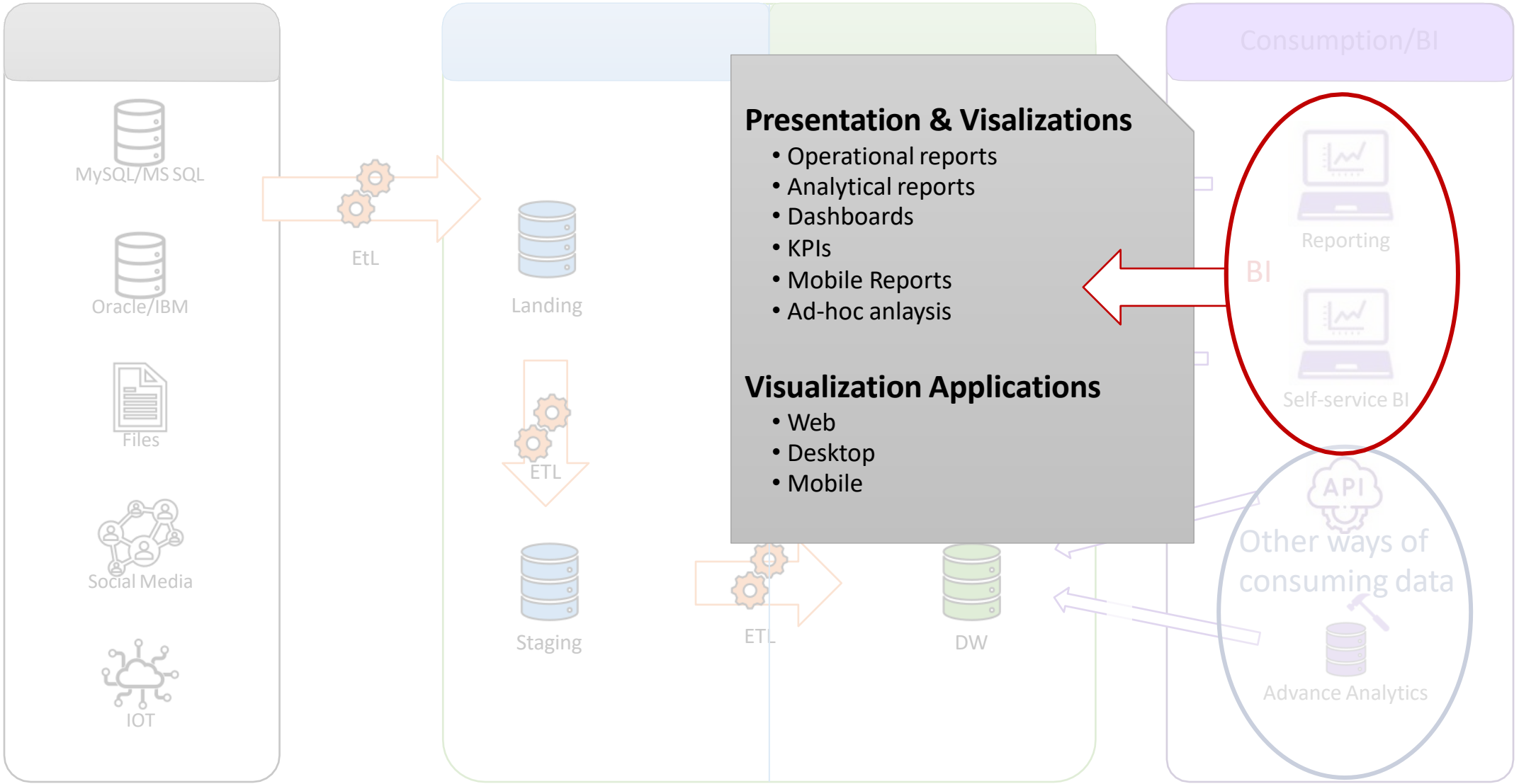
Business Intelligence Process



BI Process with Predictive Analytics



Business Intelligence Layers



Data Visualization

- Data visualization is the graphical representation of information and data
- By using visual elements like charts, graphs, and maps, data visualization tools provide an easier way to see and understand trends, outliers, and patterns in data
- Often data visualization tools turn patterns which are invisible in raw data format into visible patterns, that people can understand intuitively
- With the growth of the volume of data, visualization tools and technologies are essential to analyse massive amounts of information and make data-driven decisions

Common Types of Data Visualization

- Charts
- Tables
- Graphs
- Maps
- Infographics

More Specific Visualisation Types

- Area Chart
- Bar Chart
- Box-and-whisker Plots
- Bubble Cloud
- Bullet Graph
- Cartogram
- Circle View
- Dot Distribution Map
- Gantt Chart
- Heat Map
- Highlight Table
- Histogram
- Matrix
- Network
- Polar Area
- Radial Tree
- Scatter Plot (2D or 3D)
- Streamgraph
- Text Tables
- Timeline
- Treemap
- Wedge Stack Graph
- Word Cloud

When to Use Which Type?

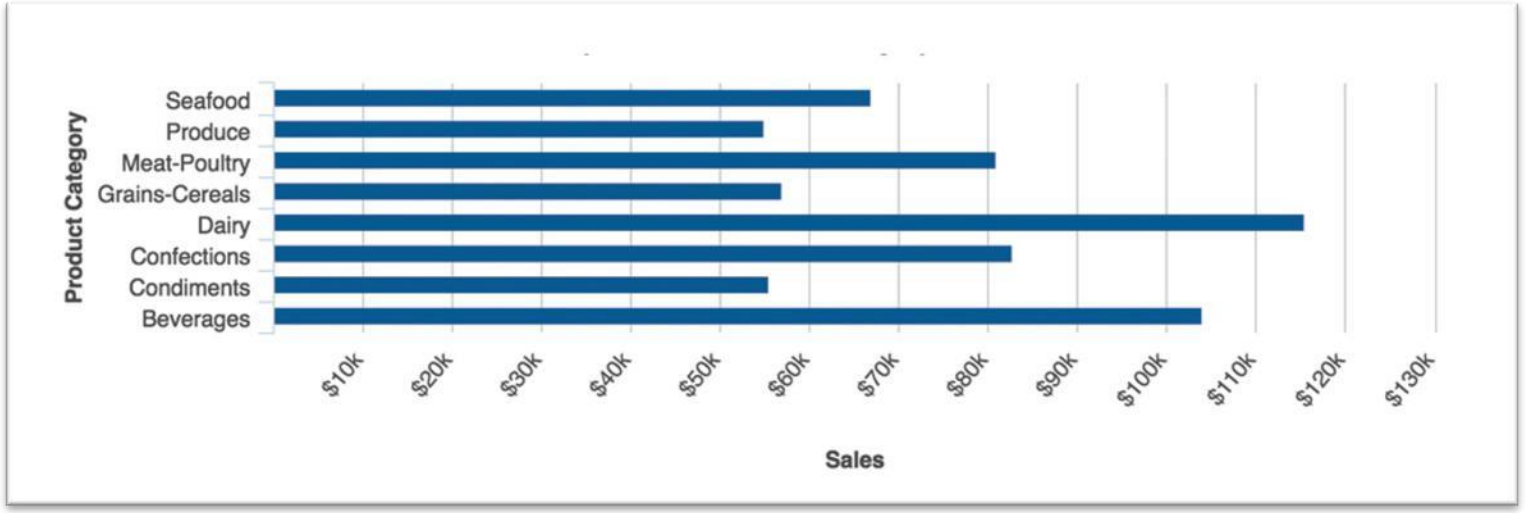
- Tabular format: best used when exact quantities of numbers must be known
  - Numbers are presented in rows and columns, and may contain summary information, as in PivotTables
  - Not suitable for finding trends and comparing sets of data
- Line charts: best used when trying to visualize continuous data over time and are ideal for showing trends in data

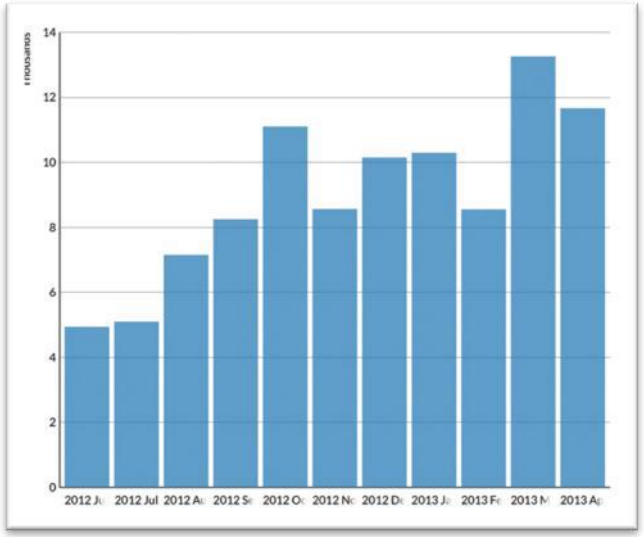
Interaction by Day of Week

Day of week	Data Hub Activities	Pages / Visit
1	20	3.30
2	14	3.22
0	8	3.26
3	2	3.48
5	2	2.39

When to Use Which Type?

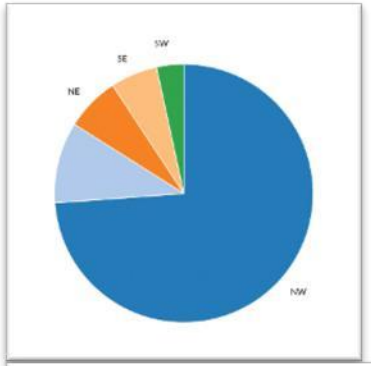
- Bar charts: best used when showing comparisons between categories
  - Typically, the bars are proportional to the values they represent and can be plotted either horizontally or vertically
  - One axis of the chart shows the specific categories being compared, and the other axis represents discrete values
  - Bar charts are ideal when you're working with limited space

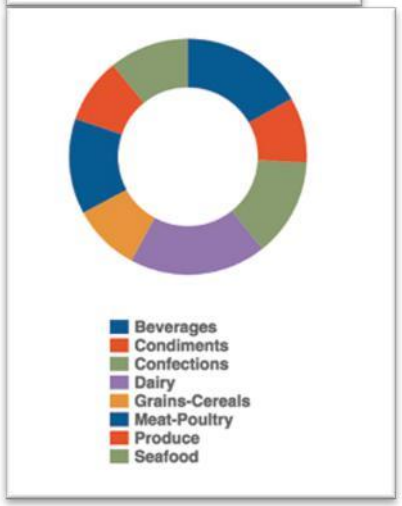


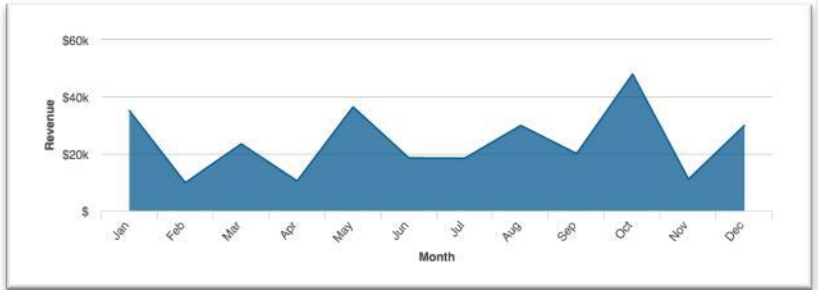


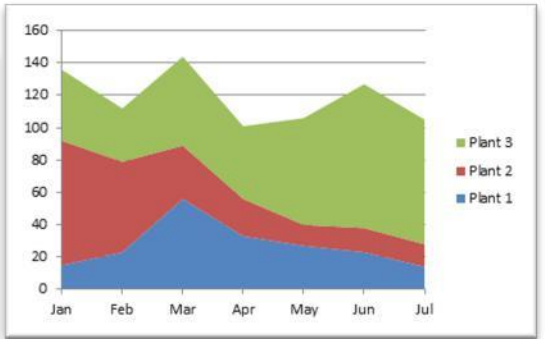
When to Use Which Type?

- Pie charts:
  - best used to compare parts to the whole
  - Pie charts make it easy for an audience to understand the relative importance of values
  - Alternate visual styles include the exploded pie wedge chart and the donut pie chart
- Area charts:
  - best used for showing cumulated totals over time via numbers or percentages
  - These are basically line charts that are filled in to provide a deeper view of multiple series of data within the chart



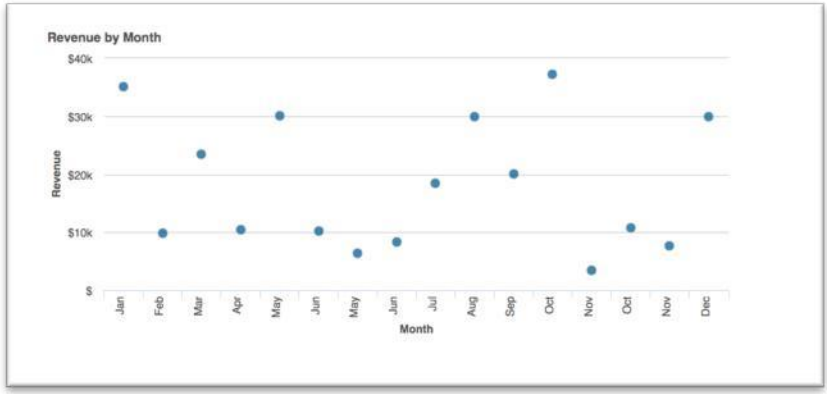


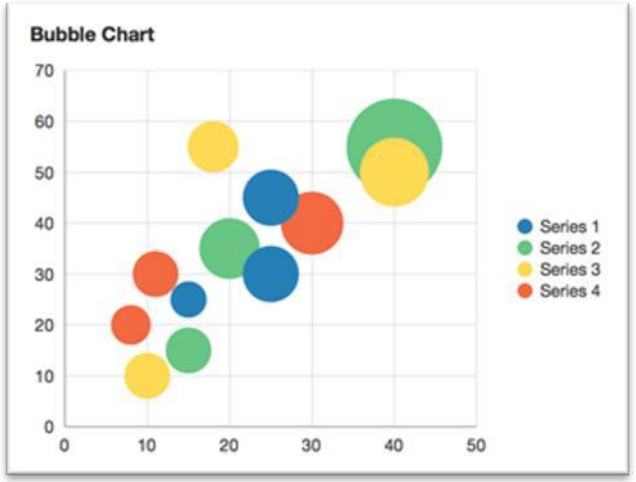




When to Use Which Type?

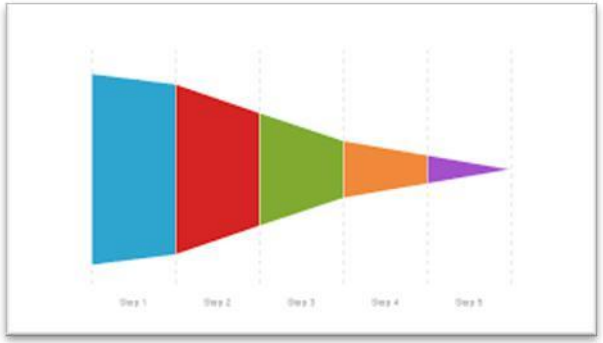
- Scatter plot:
  - best used to display relationships between 2 variables
  - The data is displayed as a collection of points; the value of one variable determines x-axis position, while the value of the other variable determines the y-axis position
  - Scatter charts work best when you have an integer value on both the Y- and X-axis; otherwise, your scatter chart will look like a line chart without the line
- Bubble charts:
  - used to show three dimensions of data—comparing entities in terms of their relative values, positions, and sizes
  - Bubble charts are similar to scatter plots, where the data





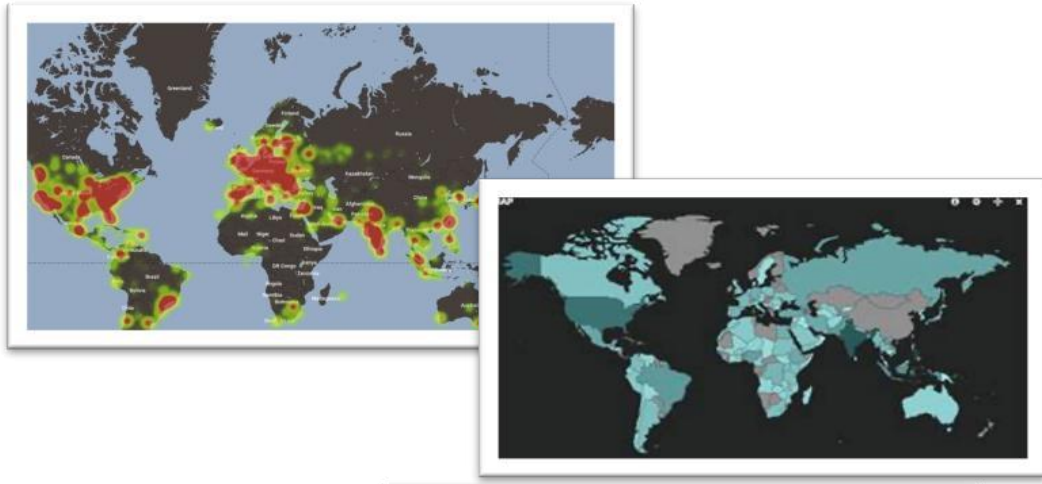
When to Use Which Type?

- Funnel charts:
  - ideal for showing stages in a particular process (e.g., sales process) or identifying potential problem areas within an organization's process
- Gauges:
  - best used to show a range
  - Ideal when you have an absolute floor value and absolute ceiling value and you want to show where the value lies within that range
  - However, gauges take up valuable space but provide limited information since they present data on a single dimension
  - They tell you whether something is on target, above target,

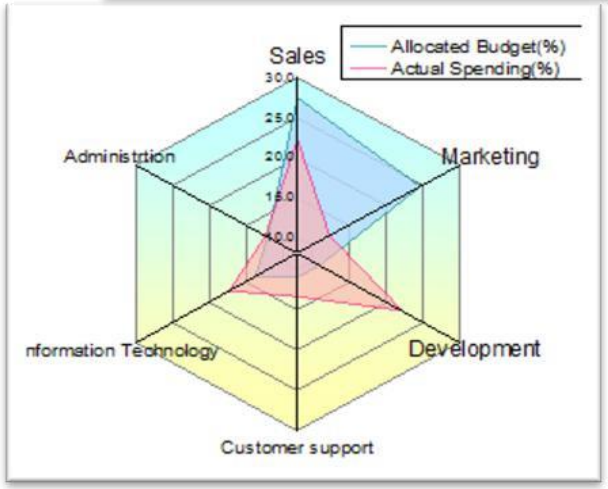


When to Use Which Type?

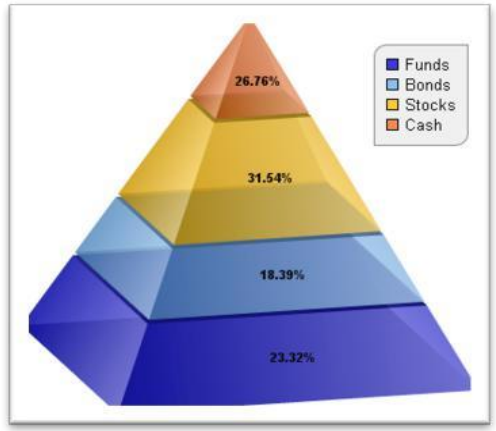
- Heat maps:
  - best for showing a representation of geographical data
  - Individual values can be shown as colours



- Polar charts:
  - best for displaying multivariate observations with an arbitrary number of variables in the form of a two-dimensional chart
  - Alternative names include radar chart, web chart, spider chart, and star chart



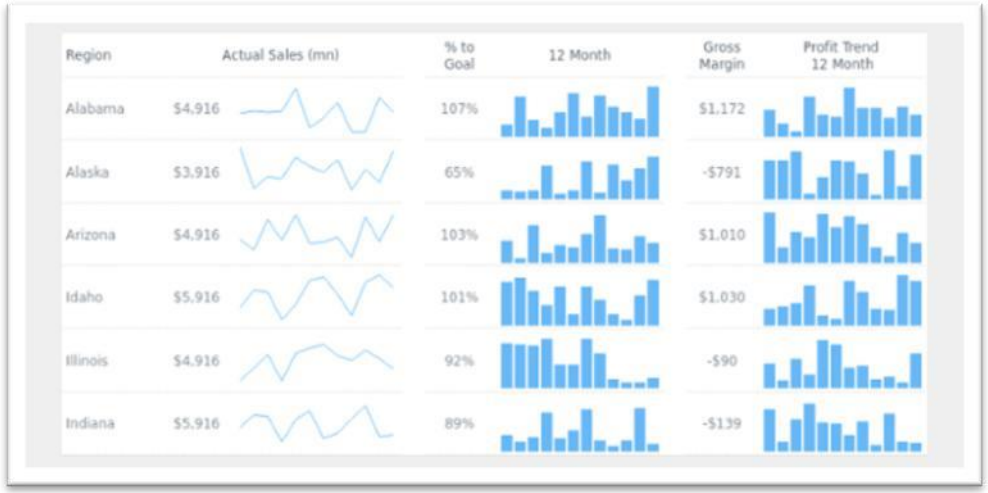
- Pyramid charts:
  - ideal for showing comparisons of data, using the thickness of layers to denote relative values

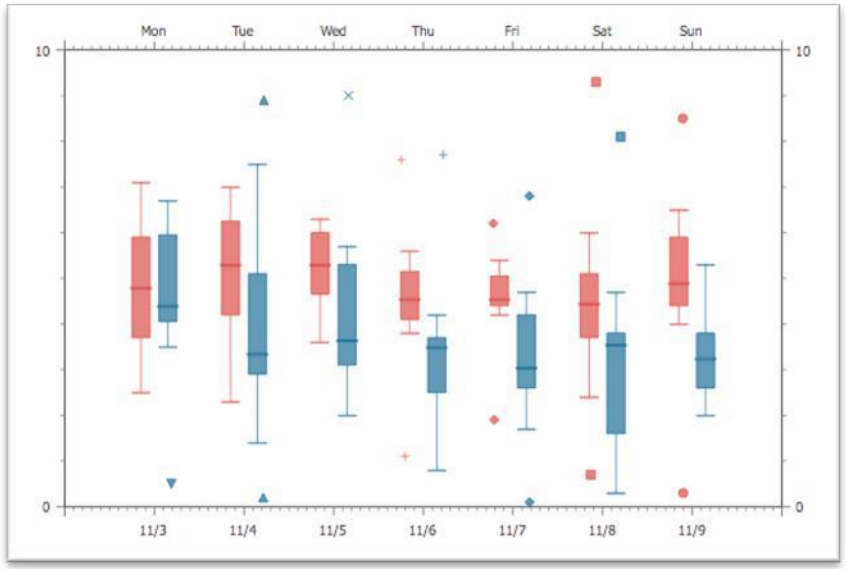


When to Use Which Type?

- Sparkline charts:
  - best for showing many trends at once
  - A prime example of a sparkline chart is the market summary
- Whisker charts or Box plots:
  - best for statistical analysis and showing the distribution of a dataset
  - The lines that extend vertically from the boxes in these charts are the “whiskers,” which denote variability outside the upper and lower quartiles
- For more types:

  https://datavizcatalogue.com/





Selection of Viaualization Type

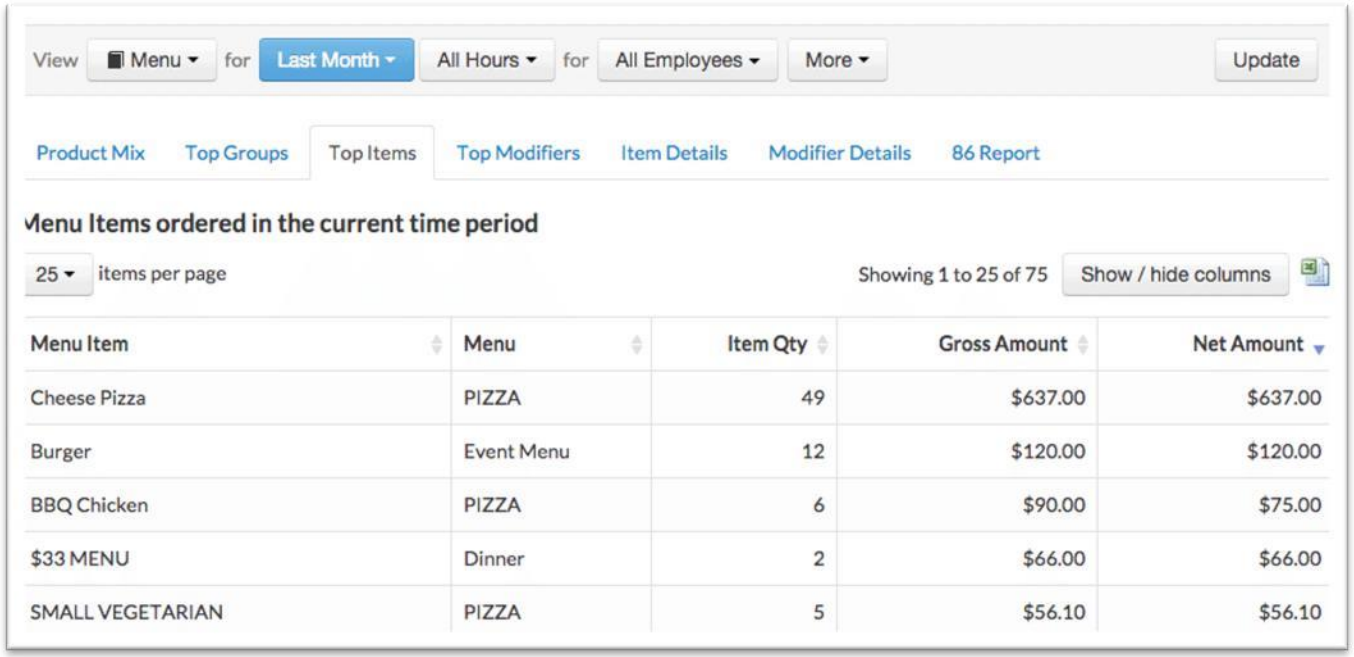
- In choosing the type of visualization, make sure you clearly understand the following points:
  - Specifics of your data set: domain knowledge of the data
  - Audience: people you want to present the information to
  - Connection logic: comparison of objects, distribution, relationship, process description, etc.
  - Output: simply, the reason for showing this information to somebody and which type to be used for that reason

Ways to Present Data

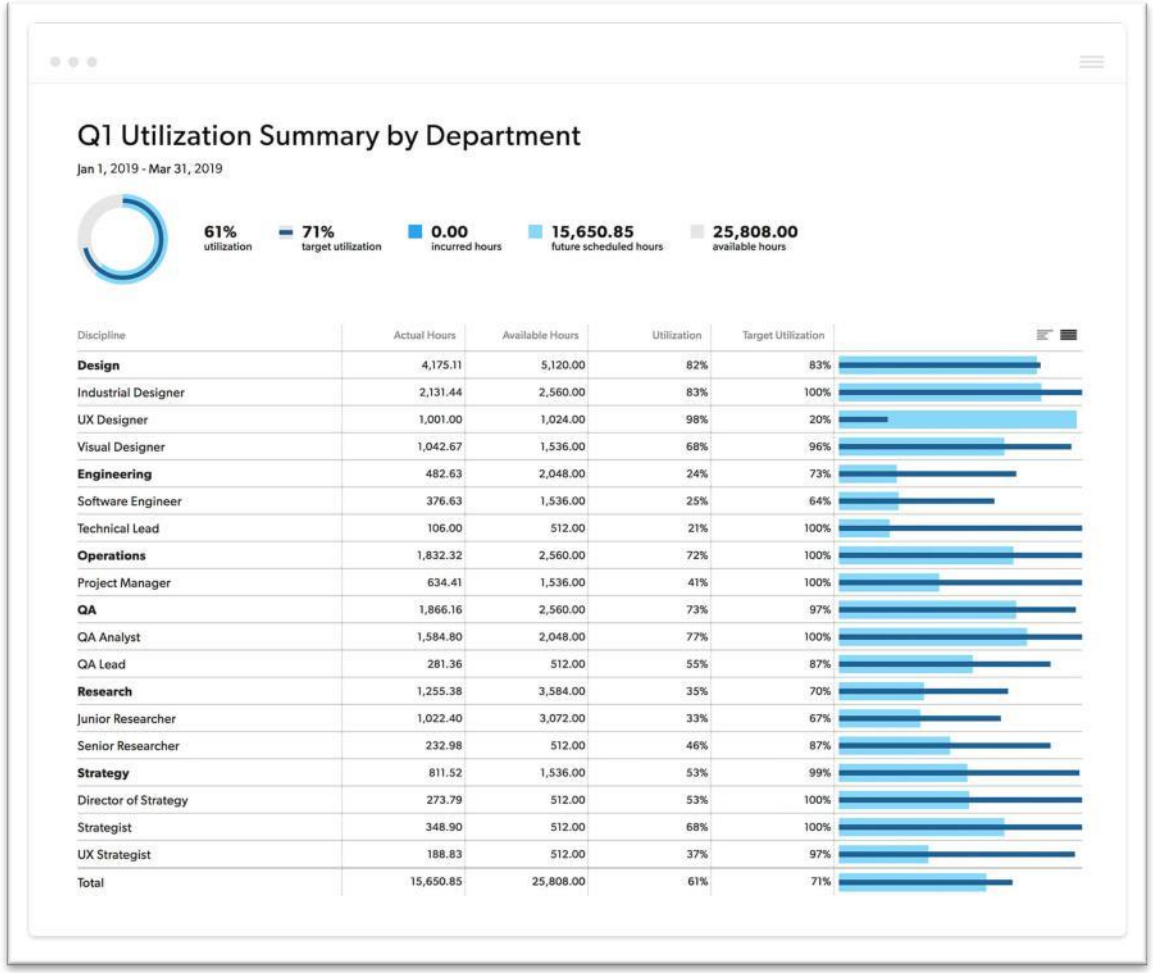
- Operational reports
- Analytical reports
- Dashboards
  - KPIs
- Scorecards
  - KPIs
- Self Service BI

- Above could be presented via web tools, mobile tools or desktop tools.

Operational Reports



Menu Item	Menu	Item Qty	Gross Amount	Net Amount
Cheese Pizza	PIZZA	49	$637.00	$637.00
Burger	Event Menu	12	$120.00	$120.00
BBQ Chicken	PIZZA	6	$90.00	$75.00
$33 MENU	Dinner	2	$66.00	$66.00
SMALL VEGETARIAN	PIZZA	5	$56.10	$56.10



Discipline	Actual Hours	Available Hours	Utilization	Target Utilization
Design	4,175.11	5,120.00	82%	83%
Industrial Designer	2,131.44	2,560.00	83%	100%
UX Designer	1,001.00	1,024.00	98%	20%
Visual Designer	1,042.67	1,536.00	68%	96%
Engineering	482.63	2,048.00	24%	73%
Software Engineer	376.63	1,536.00	25%	64%
Technical Lead	106.00	512.00	21%	100%
Operations	1,832.32	2,560.00	72%	100%
Project Manager	634.41	1,536.00	41%	100%
QA	1,866.16	2,560.00	73%	97%
QA Analyst	1,584.80	2,048.00	77%	100%
QA Lead	281.36	512.00	55%	87%
Research	1,255.38	3,584.00	35%	70%
Junior Researcher	1,022.40	3,072.00	33%	67%
Senior Researcher	232.98	512.00	46%	87%
Strategy	811.52	1,536.00	53%	99%
Director of Strategy	273.79	512.00	53%	100%
Strategist	348.90	512.00	68%	100%
UX Strategist	188.83	512.00	37%	97%
Total	15,650.85	25,808.00	61%	71%

Analytical Reports

- Provides an overall understanding of business and operational activities
- Provides capabilities to view, understand, and summarize a large amount of information about your business through data visualization
- Letting the end-user view multidimensional charts and interact with data using data visualization tools and features such as drill-up/down, slice, dice, pivot
- Can be enabled to give the end user recommendations instead of just plain numbers
    - Analytical reports are based on historical data, statistics and provide predictive analysis such as forecasting, for a specific issue

Analytical Reports

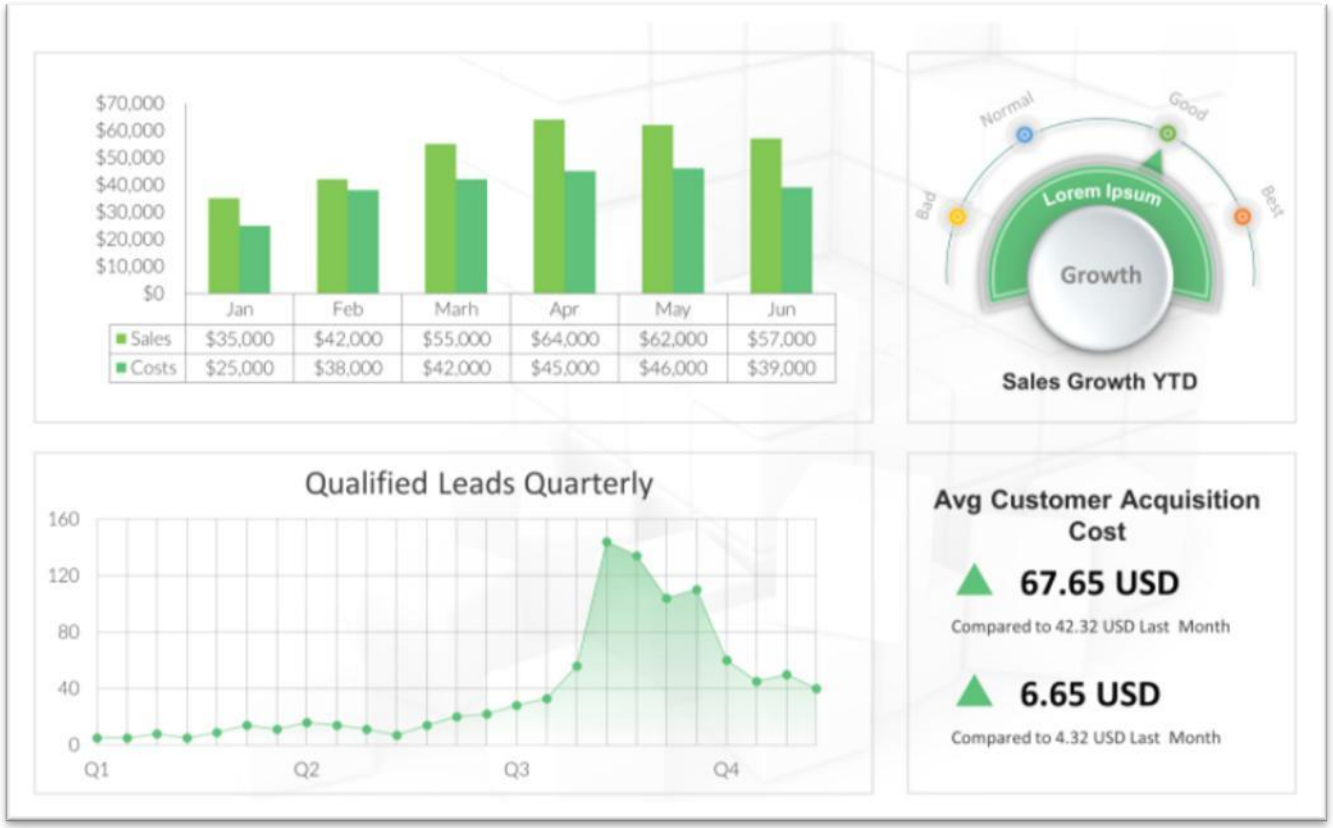
Key Performance Indicators

- A measurable value that demonstrates how effectively a company is achieving key business objectives
- Organizations use KPIs at multiple levels to evaluate their success at reaching targets
- High-level KPIs may focus on the overall performance of the business (used in scorecards), while low-level KPIs (used in dashboards) may focus on processes in departments such as sales, marketing, HR, support and others
- Start with the basics and understand what the organizational objectives are, what is the plan to achieve them, how to measure the success, and then define KPIs based on that

Dashboards

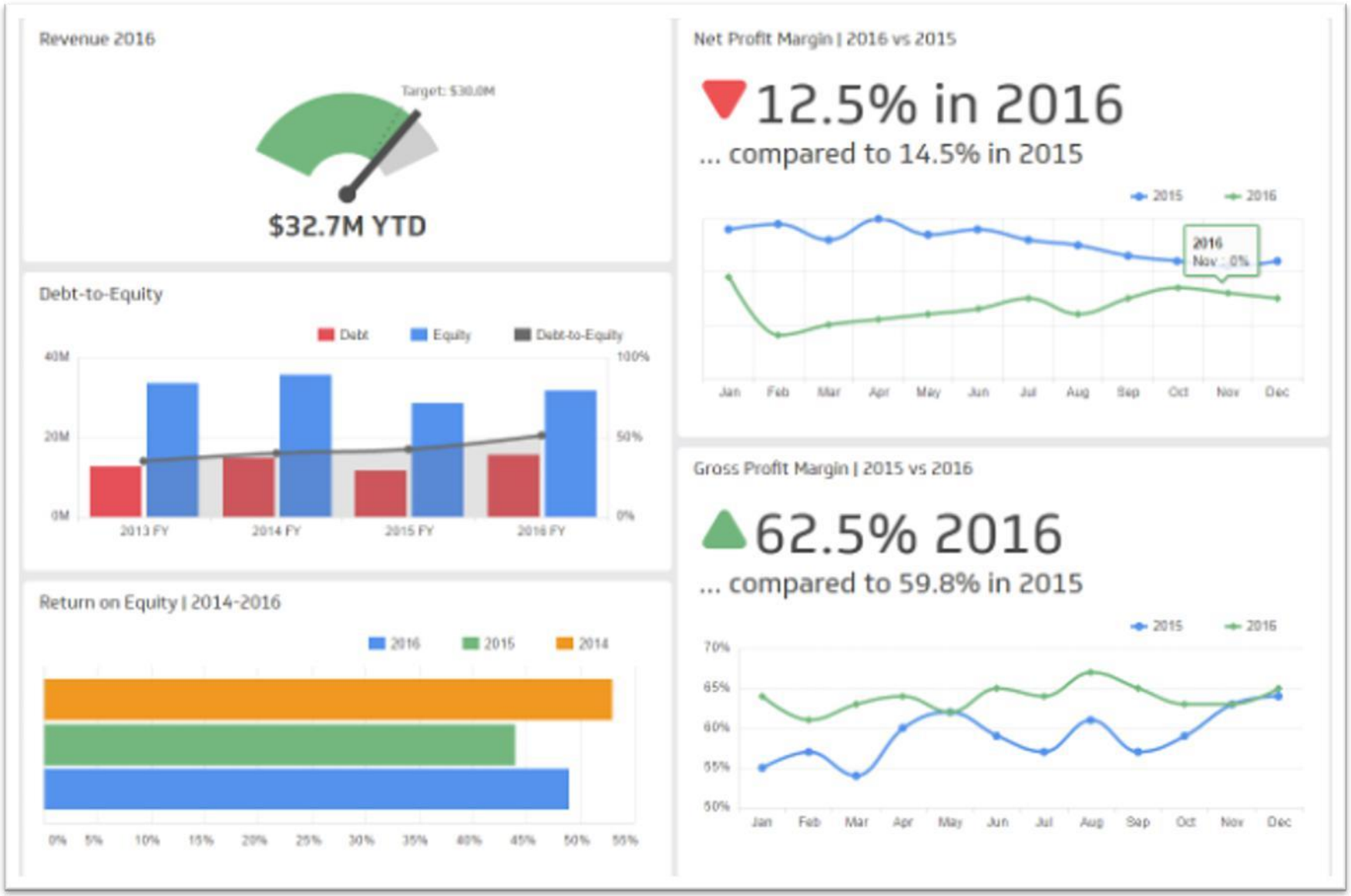
- It should be a single page of key metrics represented by tables, charts, gauges, colours, and numbers, and arranged and consolidated in such a way that the consumer can identify and focus on areas requiring immediate attention or more investigation
    - A dashboard should confine its display to a single screen with no need for scrolling or switching among multiple screens
    - Does not go into detailed information
        - Focus may lead to additional dashboards or other reports
- A business dashboard offers at-a-glance insights based on key performance indicators (KPIs) and is an intuitive and visually pleasing way to consume data

Dashboards


$70,000
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$0
Jan Feb Marh Apr May Jun
Sales $35,000 $42,000 $55,000 $64,000 $62,000 $57,000
Costs $25,000 $38,000 $42,000 $45,000 $46,000 $39,000
Bad
Normal
Good
Best
Lorem Ipsum
Growth
Sales Growth YTD
Qualified Leads Quarterly
160
120
80
40
0
Q1
Q2
Q3
Q4
Avg Customer Acquisition Cost
67.65 USD
Compared to 42.32 USD Last Month
6.65 USD
Compared to 4.32 USD Last Month


4. YTD Dashboard
Select YTD Month
JUN
Sales
108,325
Target Achievement 101%
Change Over Last Year 1%
Gross Profit
31,020
Target Achievement 108%
Change Over Last Year 6%
Operating Profit
17,513
Target Achievement 110%
Change Over Last Year 8%
Net Profit
13,968
Target Achievement 114%
Change Over Last Year 9%
Sales (Amount) by Product/Category
Above Target
Below Target
Target
Product 1 Product 2 Product 3 Product4 Product5
Actual Sales vs Target
JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN
Income Statement
108,325
77,305
13,507
844
4,380
13,968
Net Operating Cash Flow
Monthly Sales Growth
Employee Cost vs Sales
Sales
Employee Cost
Employee Cost %
Headcount
126
Change vs Last Year 1%
Male
Female
Days Receivable Outstanding
93
Receivable Aging
Total Receivable
1,350
Days Inventory Outstanding
64
Inventory Trend

Dashboards


Revenue 2016
Target: $30.0M
$32.7M YTD
Debt-to-Equity
Debt
Equity
Debt-to-Equity
40M
20M
0M
100%
50%
0%
2013 FY
2014 FY
2015 FY
2016 FY
Return on Equity | 2014-2016
2016
2015
2014
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
50%
55%
Net Profit Margin | 2016 vs 2015
12.5% in 2016
... compared to 14.5% in 2015
2015
2016
2016
Nov : 0%
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Gross Profit Margin | 2015 vs 2016
62.5% 2016
... compared to 59.8% in 2015
2015
2016
70%
65%
60%
55%
50%
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Dashboards


Total Accounts Receivable
$6,621,280
Total Accounts Payable
$1,630,270
Equity Ratio
75.38 %
Debt Equity
1.10 %
Current Ratio
1.86%
DSI
10 Days
DSO
7 Days
DPO
28 Days
Total Accounts Receivable and Payable Aging
Accounts Receivable
Accounts Payable
Net Working Capital vs Gross Working Capital
Net Working Capital
Gross Working Capital
Profit and Loss summary

Scorecards

- Scorecards offer organizations a snapshot of their current performance when compared to their goals
- They are useful tools for organizations which need to manage performance and make strategic decisions better based on the distance between current performance and the goal.

- As such, scorecards present a more static view of an organization at a point in time rather than a dynamic hub with live data to monitor success.

- Scorecards serve to monitor strategic goals relative to KPIs and to make decisions on a larger scale.

- These decisions can include tracking the progress of a set strategy, measuring the efficiency of particular teams or departments towards meeting goals or even identifying problems and how they can be resolved

- Scorecards are generally periodic measures, usually updated at set intervals such as weekly or monthly

Scorecards vs. Dashboards

Unlike scorecards, dashboards are used as a monitoring tool in real-time

- Data is constantly updated, giving organizations an opportunity to track their operational performance in real time

- As opposed to progress, dashboards measure performance, tracking metrics without comparing them to target values
- Dashboards are used daily in organizations as they offer a more operational view of success than scorecards' focus on strategic goals
- Data available in dashboards is used to provide a foundation for better decision making and more efficient day-to-day management of teams, resources, and expenses
- More importantly, dashboards help organizations view their historic data as a function of current performance. For example, companies can see their revenues over the past 12 months or measure their month-to-month sales growth on an ongoing basis
- For example, sales performance scorecard may show performance related to sales, revenue and profit against target or budget estimates

Scorecards vs. Dashboards

Comparison based on	Dashboard	Scorecard
Purpose	Performance Monitoring	Performance Management
Parameters	Performance Metric	KPI (Metric + Target)
Measures	Performance	Progress (Current value versus the target)
Updates information	Real Time Basis	Periodically (Weekly/Monthly/Quarterly)
Focused On	Short Tem Goal	Long Term Goal
Decision Influences	Daily Operations	Companies Policies
Nature of Decisions	Tactical	Strategic
Supported By	Individual Managers	Top Management
Provides	Snapshot of Business Performance	Trends and changes in business activity over period of time.
Nature of Data	Real Time data obtained	Summarized/ Consolidated

Developing Dashboards: Some Guidelines

1. Define your dashboard audience and objective (requirements)
    1. Who is your audience?
    2. What do they do on a daily basis?
        - Differences in daily tasks will result in different goals and KPIs
            - Daily life of a sales agent who has to get all of their own leads is quite different from the daily work of a sales agent who has all of their leads supplied to them
            - Daily life of the sales manager who is in charge of all the sales agents is more different still
    3. What goals are they trying to reach?
        - e.g., achieving more sales, getting more leads, completion of projects, etc.

Developing Dashboards: Some Guidelines

2. Define your dashboard audience and objective (cont.)
    1. What KPIs, if measured, will help them reach their goals?
        - KPIs must be set against goals: sales growth, customer acquisition, project completion %, etc.
    2. How are they currently viewing these KPIs?
        - What are their pain points in current process?
    3. How can I use storytelling to put my KPIs into context?
        - To get results, storytelling should become a primary focus.
        - Avoid providing all the information you got, but the best information to aid in getting the actionable insights they need
        - Interactive visualizations are especially relevant when you have a broad target audience

Developing Dashboards: Some Guidelines

3. Select the right chart type for your data
    1. What story do you want to tell?
        - Data-driven storytelling is a powerful force as it takes stats and metrics and puts them into context through a narrative
        - Knowing what kind of story or message you want to convey will help to choose the right data visualization types
            - Analyse trends (line charts, column charts, area charts)
            - Demonstrate a composition (pie charts, waterfall charts, stacked charts, map-based graphs)
            - Compare sets of values (bubble charts, spider charts, bar charts, columned visualizations, scatter plots)
    2. Who do you want to tell it to?
        - Based on the audience, which data visualization types will make the most tangible connection with the people will defer
    3. How do you want to show your KPIs?
        - Comparing data or demonstrating a relationship or demonstrating a trend

Developing Dashboards: Some Guidelines

3. Don’t forget about colour theory
4. Build a balanced perspective
5. Make sure your dashboard is mobile-optimized

Developing Dashboards: DO's and DON'Ts

- DO'S
  - DO focus on the needs of your audience
  - DO keep your dashboards as simple, clean, and minimalist as you can while including most important KPIs as necessary
  - DO make sure that your final dashboard is better than your audience's previous method of viewing their KPI
  - DO tell a story, as stories are easily understood by the human mind
- DON'Ts
  - DON'T clutter your dashboard with too much data. This is the number one rule to follow!
    - Too much data too hard to use waste of time
  - DON'T use colours that are very similar in brightness as your main colours
    - Colour blind people won't be able to use your dashboard
  - DON'T make a "one size fits all" dashboard; make it with specific people and needs in mind
  - DON'T use pie charts except in cases where you are showing parts of a whole

Top BI Tools

- Microsoft Power BI (good for SSBI too)
- Tableau (good for SSBI too)
- Qlik Sense and QlikView (good for SSBI too)
- SAP BusinessObjects BI Suite
- Sisense (great for SSBI too)
- SQL Server Reporting Services (SSRS)
- Microstrategy
- TIBCO Spotfire
- IBM Cognos Analytics
- Oracle Business Intelligence Enterprise Edition
- Amazon QuickSight
- SAS Enterprise Guide

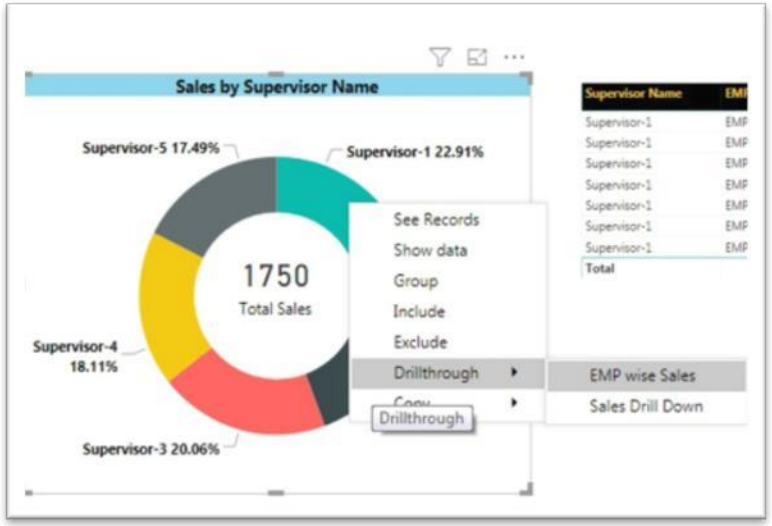
Some Well-Known Features in Visualizations

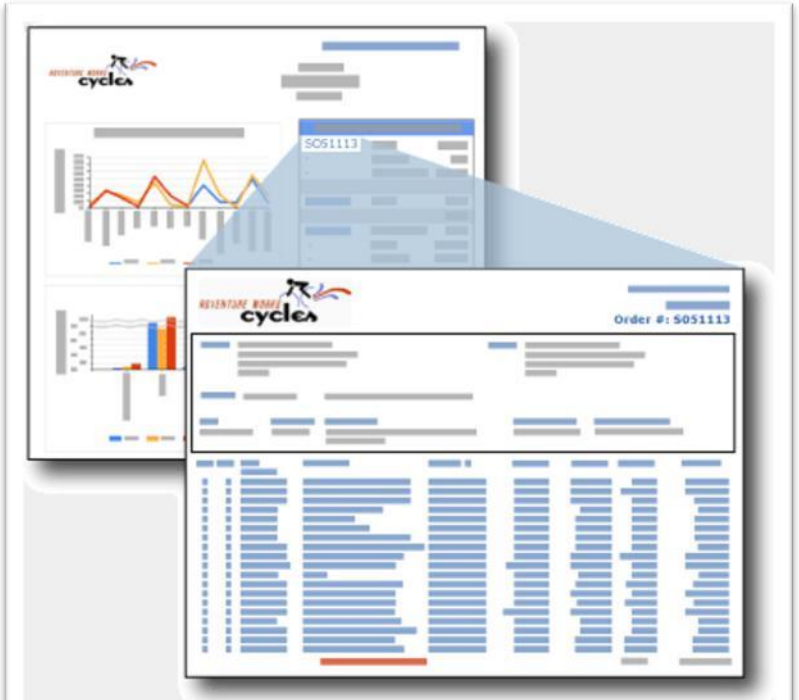
- Drilldown: take users from a more general view of the data to a more specific one, enabling them to dig deeper into the layers in a hierarchy.
  - For example, in a report that shows sales revenue by country, the user can select a country and then drill down to see sales revenue by province, state, or city

Country	State Province	City	Postal Code	Internet Sales Amount
⊞				29358677.2207
⊞ Australia				2524846240.9802
⊟ Canada	⊞			29358677.2207
	⊞ Alberta			146793386.1035
	⊟ British Columbia	⊞		29358677.2207
		⊞ Burnaby		205510740.5449
		⊟ Cliffside		29358677.2207
			V8Y 1L1	29358677.2207
		⊞ Haney		58717354.4414
		⊞ Langford		58717354.4414
		⊞ Langley		58717354.4414

Some Well-Known Features in Visualizations

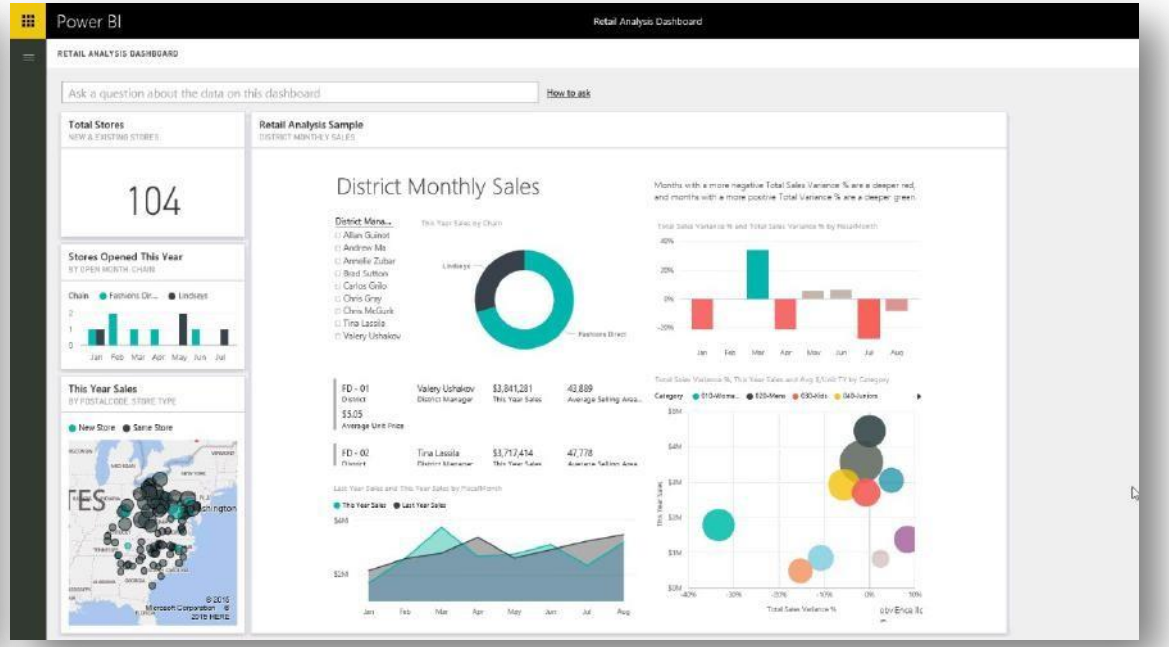
- Drill-through: allow users to pass from one report to another while still analysing the same set of data
  - For example, in a tabular report that shows sales revenue by state, the user can drill through to reveal an analysis grid of the same data, or perhaps a heat map representing the data in visual form





Some Well-Known Features in Visualizations

- Slice/Dice: data visualized in the report can be sliced and diced with slicers



Challenges Related to Visualization Process

- Defining visualization is somewhat less technology driven
- While there are semi-AI driven business intelligence tools, the user is still the one who decides what format of visualization will be placed on a canvas, and what will be the data properties
- Thus, we sometimes tend to use unsuitable visualizations to tell a specific story!

- Pitfall 1: using the wrong visualization format
  - It's very easy to get lost in the forest of graphs, charts, and maps, so it will take some time to study the required or most suitable visualization for the business/audience
  - For example, using a spider chart when the object has only one characteristic to compare will make everyone scratch their heads or a line graph applied to compare multidimensional units, like seasonal sales across 3 countries, each with 10 provinces, is doomed to failure!
- Pitfall 2: using the wrong type of data
  - A very similar issue, but it takes a couple of times to understand what type of data can be applied to your tried-and-tested visualizations

Challenges Related to Visualization Process

- Pitfall 3: visualization tools don’t generate reports, you do!
  - Only a few really expensive tools can interpret some part of the information for you
- Pitfall 4: wrong tooling choice
  - If a decision is made to use a free tool or decide to mess with libraries in the tool, perhaps it can’t be wrong for you.
  - But when we talk about the choice of vendor, things get more serious
    - Vendors of data visualization offer the whole service to make your life easier
    - But it is important to understand whether the service is scalable, so it covers the amount of data, frequency of updates, number of users (total/concurrent)
    - Visualization capabilities should also be considered, because industry-specific analytics may include exotic forms of visualizations and other features such as support for mobile devices