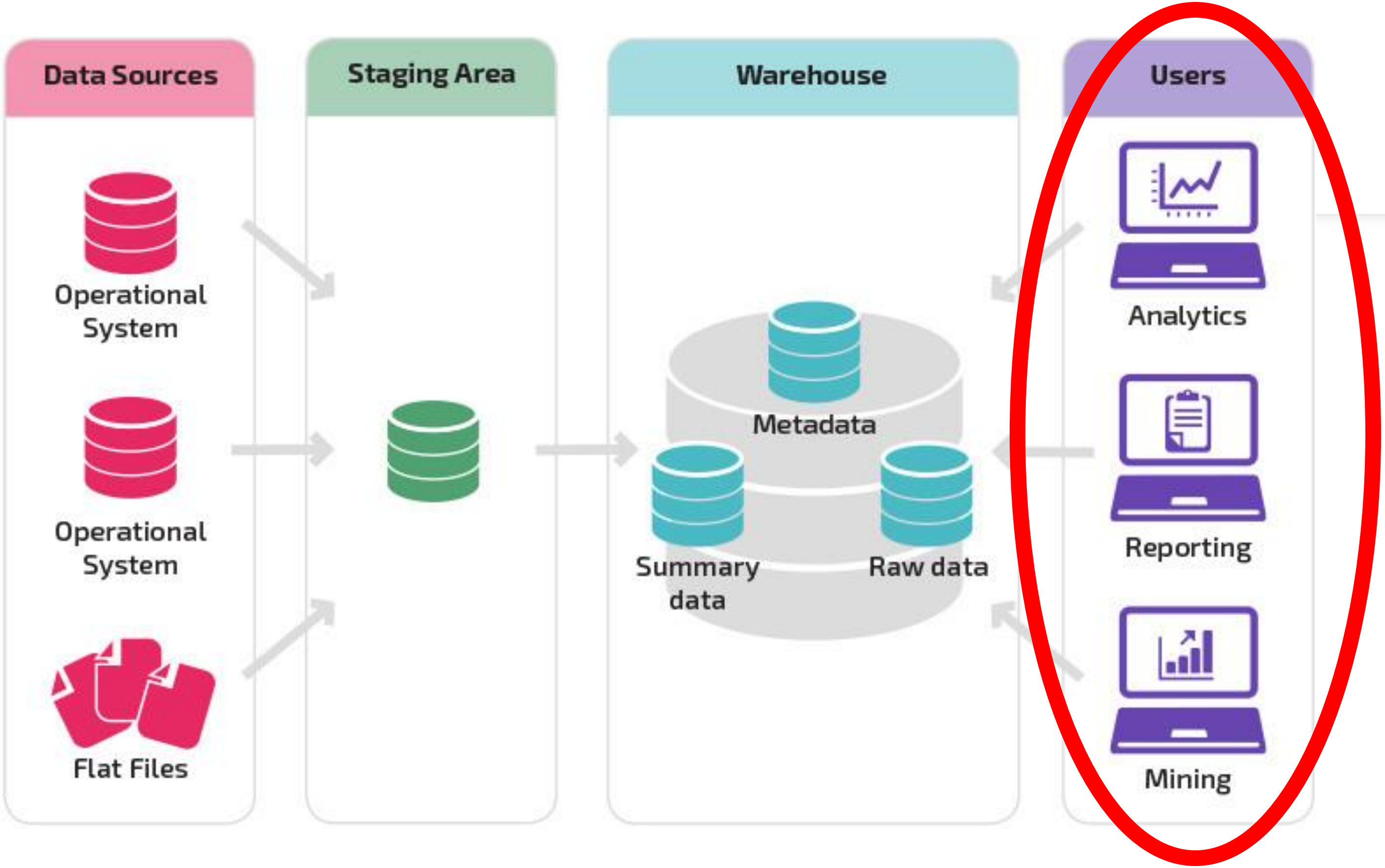
CS 459
Business Intelligence

The Final Chapter!

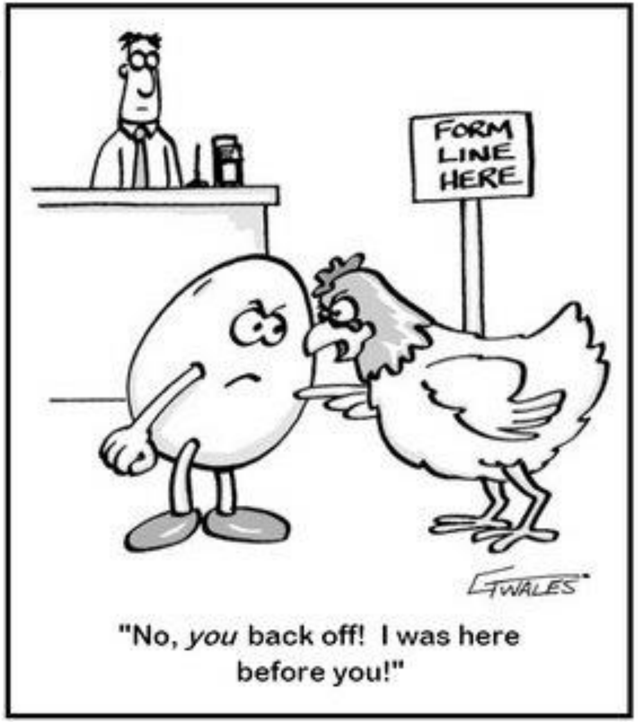

Data Sources
Staging Area
Warehouse
Users
Operational System
Operational System
Flat Files
Metadata
Summary data
Raw data
Analytics
Reporting
Mining

Data Warehouse or Business Intelligence?

Is the **data warehouse** a component of **business intelligence**?

or

Is **business intelligence** a component of the **data warehouse**?



"No, *you* back off! I was here before you!"

BI Dashboarding
Best Practices and Techniques

(Examples from Tableau)

CS 459 Business Intelligence

Dashboard Vs Report

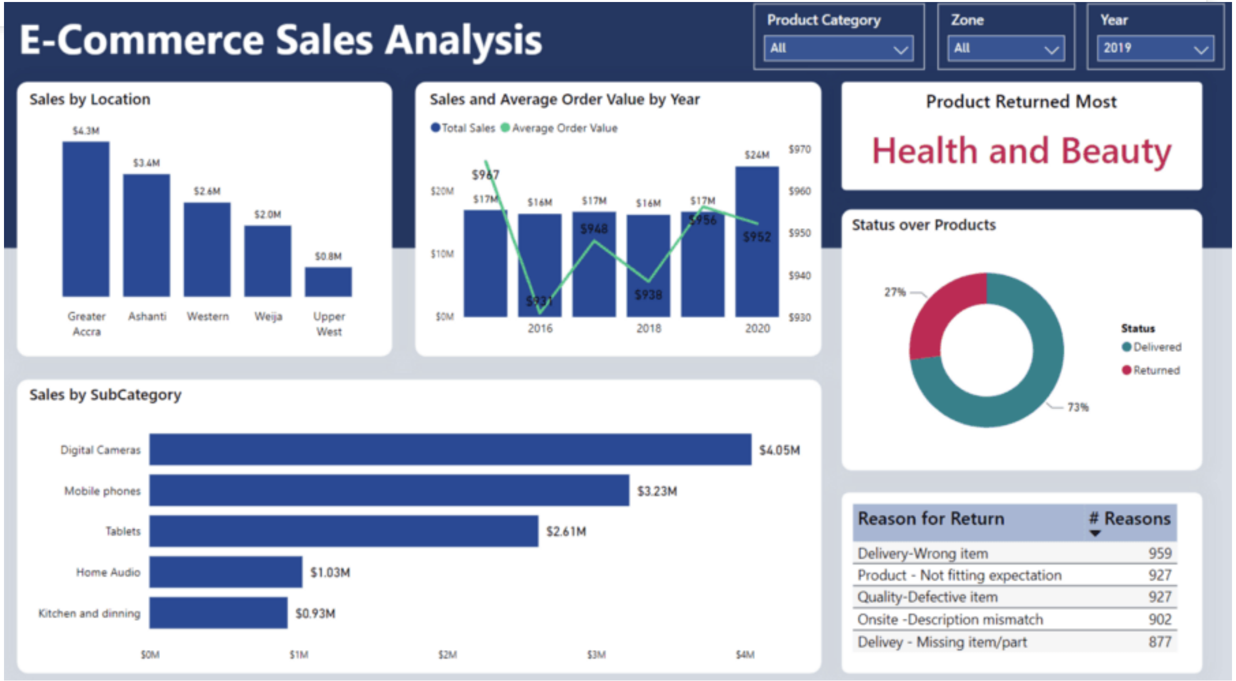
	Dashboard	Report
Purpose	Used for high-level monitoring, often in real-time or near-real-time, providing a consolidated view of business performance	Used for in-depth analysis and exploration of data to answer complex business questions.
Interactivity and Structure	Limited interactivity – single page view at a glance.	Greater interactivity – detailed multi-page analysis.
Updates	Designed for real-time or near real-time updates making monitoring of live data easy.	Focused on historical data and may require periodic updates enabled through PowerBI scheduled refresh capabilities.
Use case	Quick sharing of insights across organization	More suited for detailed analysis allowing for specific aspects of the data.

Dashboard

Monitoring e-Commerce Sales

A quick review of all KPIs.

A well-designed dashboard enable spotting problems quickly.



E-Commerce Sales Analysis

Product Category: All

Zone: All

Year: 2019

Product Returned Most

Health and Beauty

Reason for Return	# Reasons
Delivery-Wrong item	959
Product - Not fitting expectation	927
Quality-Defective item	927
Onsite -Description mismatch	902
Delivey - Missing item/part	877

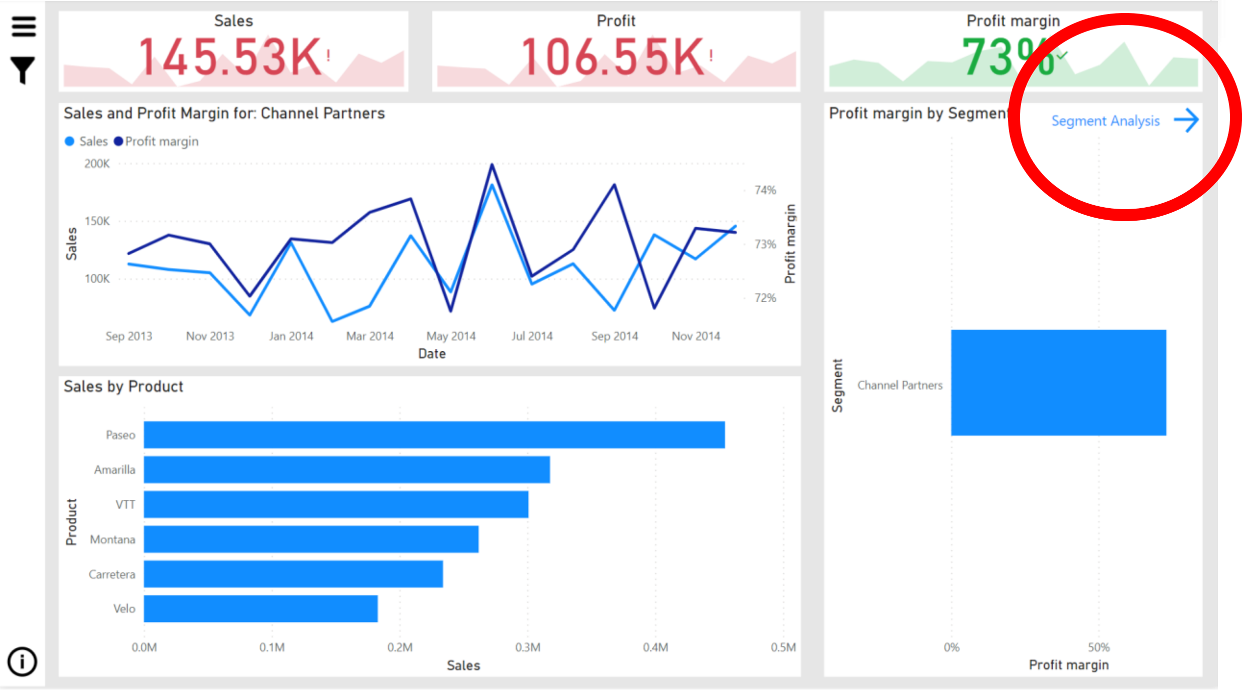
Sales by Location
$4.3M
$3.4M
$2.6M
$2.0M
$0.8M
Greater Accra
Ashanti
Western
Weija
Upper West
Sales and Average Order Value by Year
Total Sales
Average Order Value
$20M
$10M
$0M
$17M
$16M
$17M
$16M
$17M
$24M
$967
$931
$948
$938
$956
$952
$970
$960
$950
$940
$930
2016
2018
2020
Status over Products
27%
73%
Status
Delivered
Returned
Sales by SubCategory
Digital Cameras
Mobile phones
Tablets
Home Audio
Kitchen and dinning
$4.05M
$3.23M
$2.61M
$1.03M
$0.93M
$0M
$1M
$2M
$3M
$4M

Source: DataCamp

Report

Analyze impact of a recent promotional campaign on sales.

Review the sales by different dimensions.

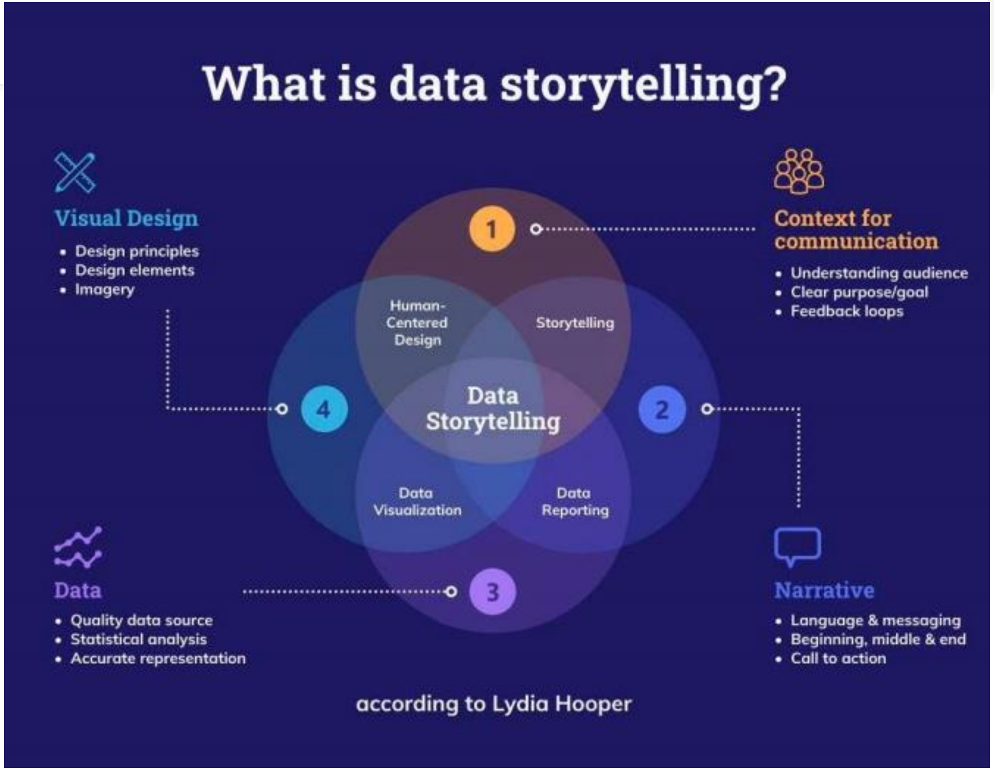


Sales
145.53K
Profit
106.55K
Profit margin
73%
Sales and Profit Margin for: Channel Partners
● Sales ● Profit margin
200K
150K
100K
Sales
74%
73%
72%
Profit margin
Sep 2013
Nov 2013
Jan 2014
Mar 2014
May 2014
Jul 2014
Sep 2014
Nov 2014
Date
Profit margin by Segment
Segment Analysis →
Segment
Channel Partners
0%
50%
Profit margin
Sales by Product
Paseo
Amarilla
VTT
Montana
Carretera
Velo
Product
0.0M
0.1M
0.2M
0.3M
0.4M
0.5M
Sales

Source: DataCamp

Data Story Telling

- Data storytelling is the concept of building a compelling narrative based on complex data and analytics that help tell your story and influence and inform a particular audience.


What is data storytelling?
Visual Design
• Design principles
• Design elements
• Imagery
Context for communication
• Understanding audience
• Clear purpose/goal
• Feedback loops
1
2
3
4
Human-Centered Design
Storytelling
Data Storytelling
Data Visualization
Data Reporting
Data
• Quality data source
• Statistical analysis
• Accurate representation
Narrative
• Language & messaging
• Beginning, middle & end
• Call to action
according to Lydia Hooper

A good story is…

- Relevant to the audience , the business domain and specific problem being solved.
- Uses good data – collected form reputable sources that convey the true story.
- Forms a clear narrative – introduce the topic before diving in.
- Uses Smart visuals (charts/images/etc)– convey the intended purpose. Well labelled, legible, not misleading

What is a dashboard?

- "A dashboard is a visual display of the most important information to achieve one or more objectives; consolidated and arranged on a single screen so the information can be monitored at a glance."

- Stephen Few

PowerBI, Tableau, Qlik…

- Variety of charts
- Simple Vs Complicated

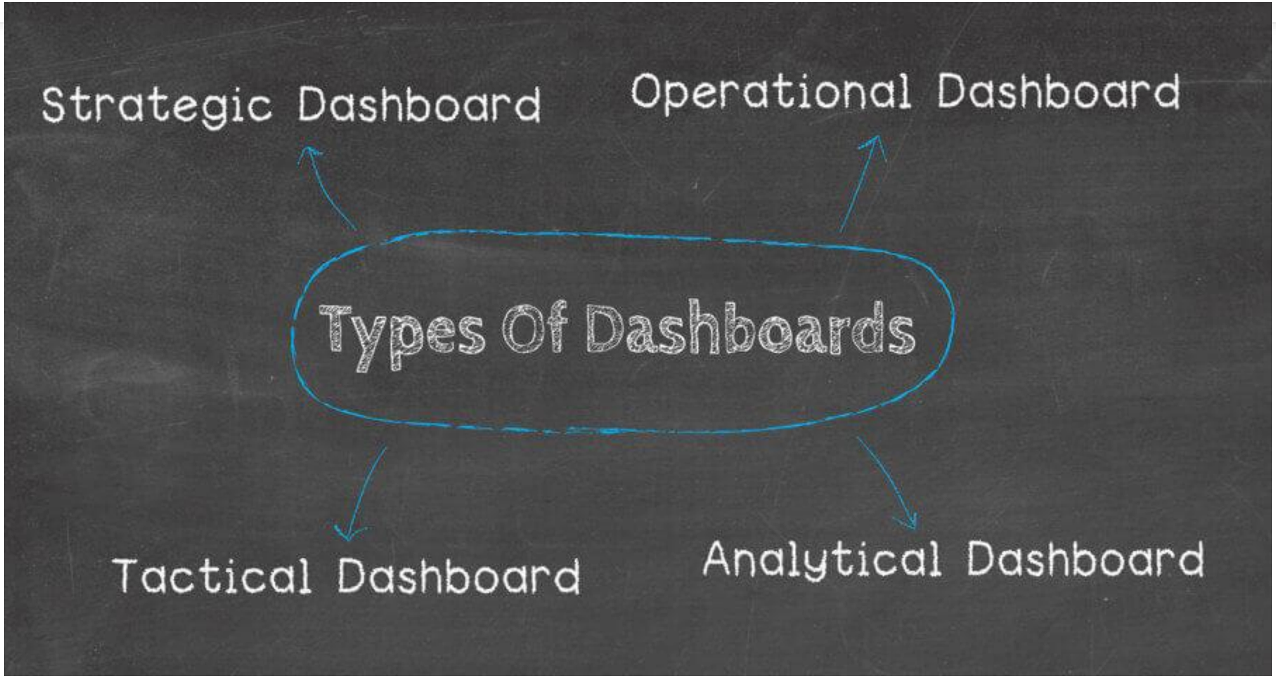
- What should a dashboard have?
- How does it solve a problem?

Dashboard

- A single page solution to a business problem offering insights
- Understand in a matter of seconds
- Includes charts, labels and numbers

Types of Dashboards

Types of Dashboards


Strategic Dashboard
Operational Dashboard
Types Of Dashboards
Tactical Dashboard
Analytical Dashboard

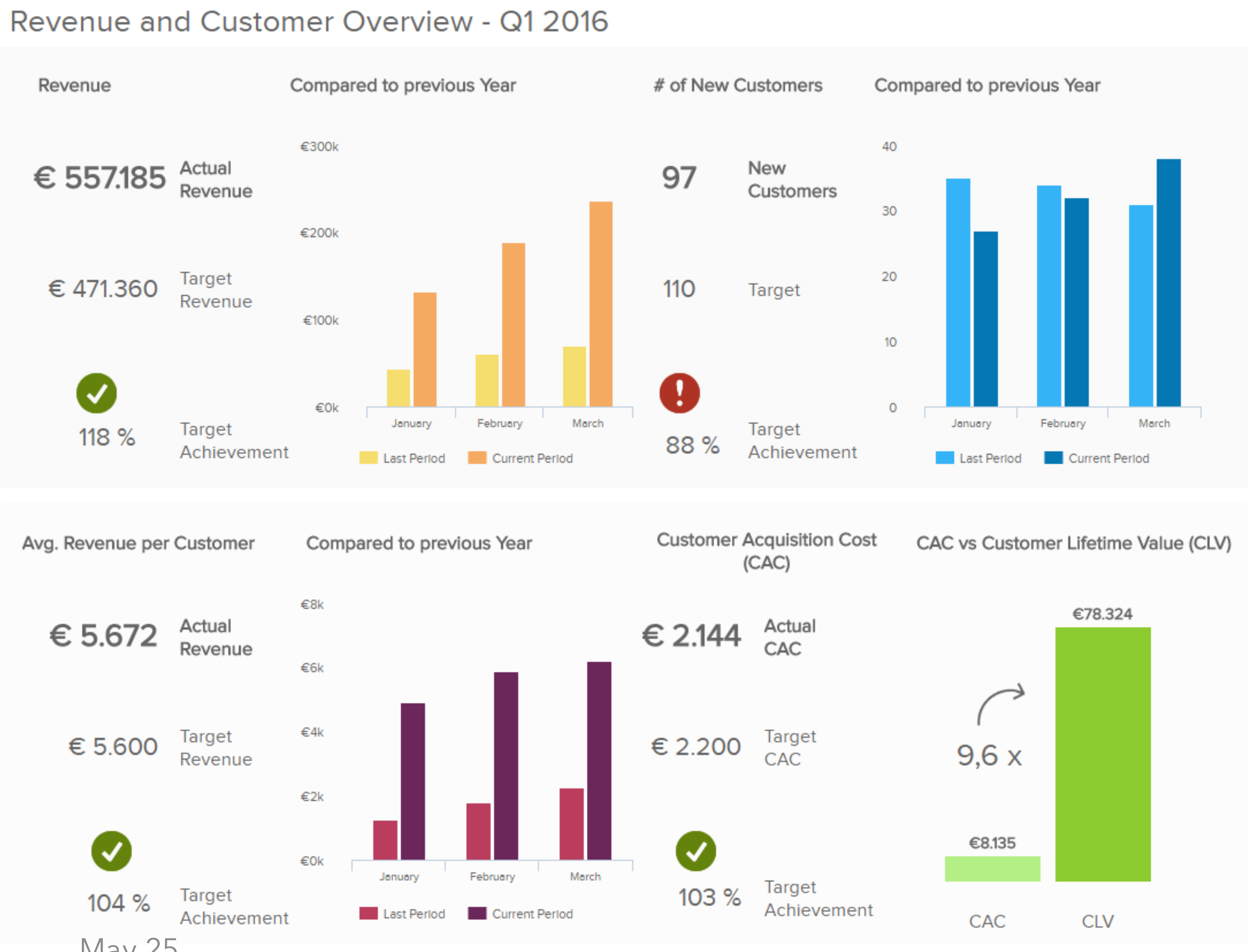
Types of Dashboards

1. **Strategic** - focused on long-term strategies and high-level metrics
2. **Operational** - shows shorter time frames and operational processes.
3. **Analytical** - contains vast amounts of data created by analysts.
4. **Tactical** - used by mid-management to track performance.

Strategic Dashboards

- **Long-term** organizational strategies
- User**: Senior-level** decision makers
- Track critical KPIs against enterprise-wide strategic goals over set time frames
- Clear picture of strategic issues for efficient decision making
- Help identify concerns quickly
- Use of common qualitative and quantitative language for easy understanding

Management Strategic KPI dashboard



Revenue and Customer Overview - Q1 2016

Revenue

€ 557.185 Actual Revenue

€ 471.360 Target Revenue

✓ 118 % Target Achievement

# of New Customers

97 New Customers

110 Target

! 88 % Target Achievement

Avg. Revenue per Customer

€ 5.672 Actual Revenue

€ 5.600 Target Revenue

✓ 104 % Target Achievement

Customer Acquisition Cost (CAC)

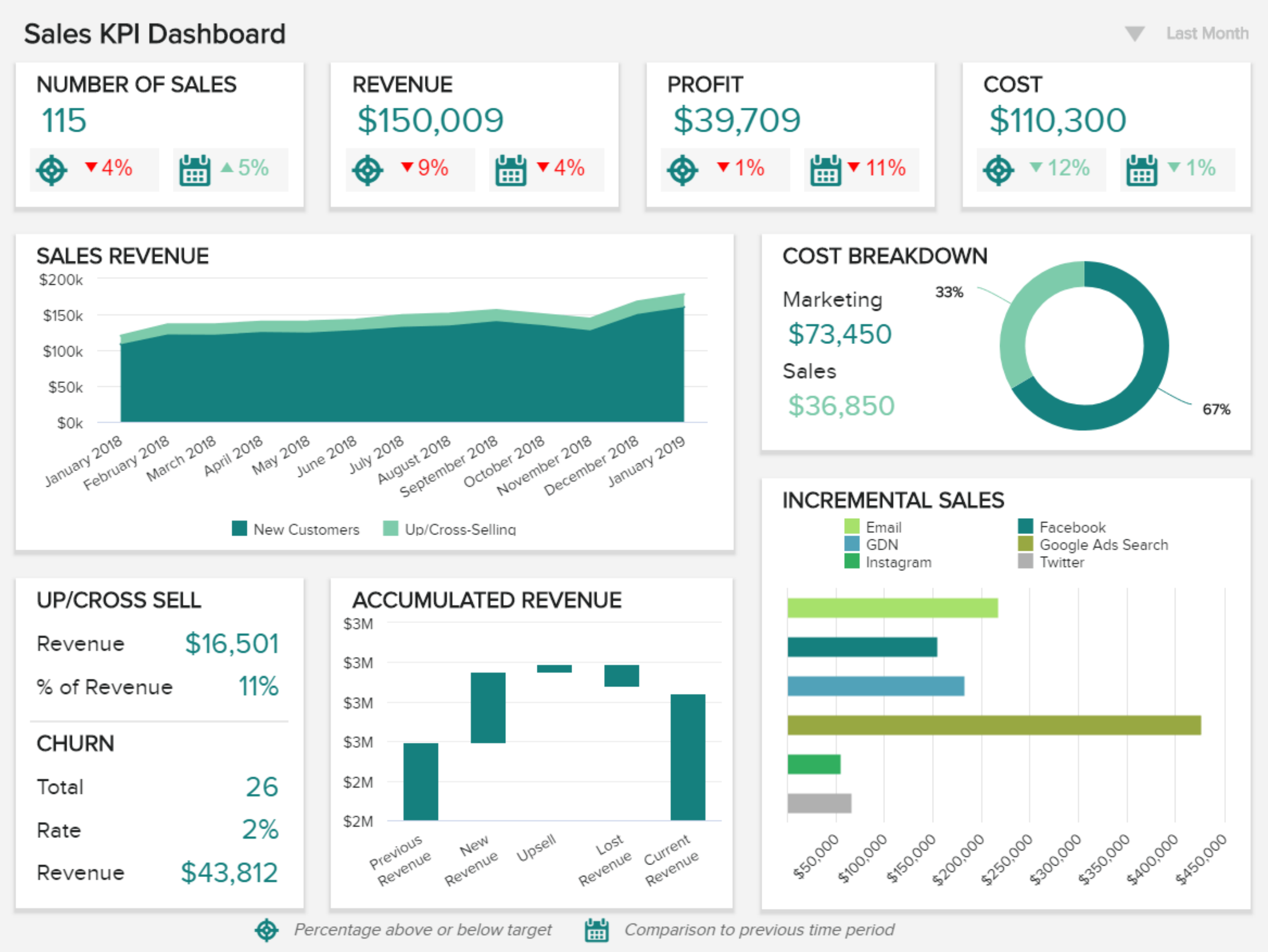
€ 2.144 Actual CAC

€ 2.200 Target CAC

✓ 103 % Target Achievement

Compared to previous Year
€300k
€200k
€100k
€0k
January
February
March
Last Period
Current Period
Compared to previous Year
40
30
20
10
0
January
February
March
Last Period
Current Period
Compared to previous Year
€8k
€6k
€4k
€2k
€0k
January
February
March
Last Period
Current Period
CAC vs Customer Lifetime Value (CLV)
€78.324
9,6 x
€8.135
CAC
CLV

- What is my customer base and revenue compared to this time last year?
- Not cluttered and quick story telling



Sales KPI Dashboard

Last Month

NUMBER OF SALES 115	▼4%	▲5%
REVENUE $150,009	▼9%	▼4%
PROFIT $39,709	▼1%	▼11%
COST $110,300	▼12%	▼1%

COST BREAKDOWN

Marketing
$73,450

Sales
$36,850

UP/CROSS SELL

Revenue	$16,501
% of Revenue	11%

CHURN

Total	26
Rate	2%
Revenue	$43,812

Percentage above or below target

Comparison to previous time period

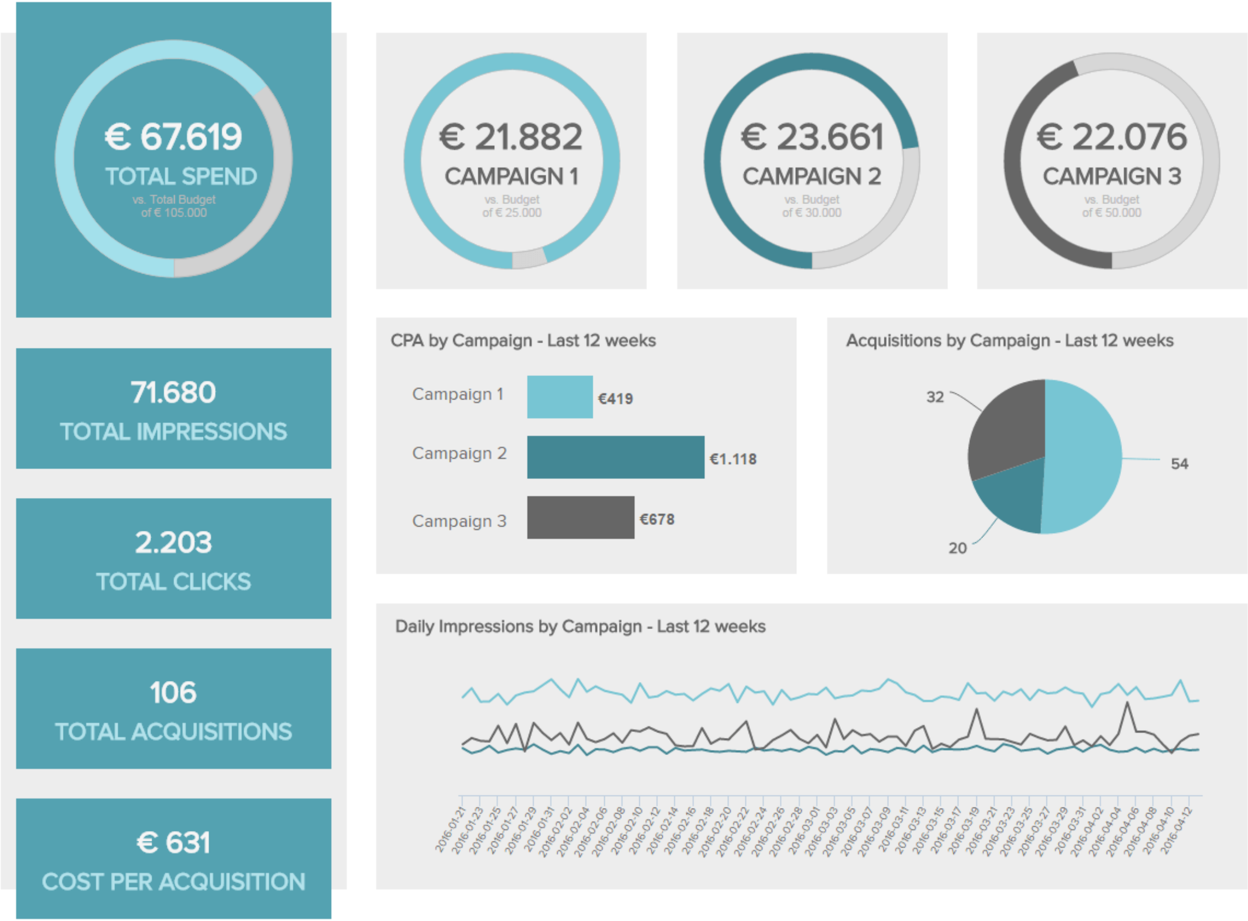
SALES REVENUE
$200k
$150k
$100k
$50k
$0k
January 2018
February 2018
March 2018
April 2018
May 2018
June 2018
July 2018
August 2018
September 2018
October 2018
November 2018
December 2018
January 2019
New Customers
Up/Cross-Selling
33%
67%
ACCUMULATED REVENUE
$3M
$3M
$3M
$3M
$2M
$2M
Previous Revenue
New Revenue
Upsell
Lost Revenue
Current Revenue
INCREMENTAL SALES
Email
GDN
Instagram
Facebook
Google Ads Search
Twitter
$50,000
$100,000
$150,000
$200,000
$250,000
$300,000
$350,000
$400,000
$450,000

Sales KPI Strategic dashboard

- High-level sales metrics for c-level executives

Operational Dashboards

- Optimize **short-term** operations
- Users: **Junior** decision makers
- Track operational processes and facilitate fast and accurate exchange of data between teams
- Identification of real-time issues for swift resolution.
- Common for monitoring business activities in specific areas
- Alert about business exceptions in real time data (Flags)
- More detailed than strategic, detail view of specific data

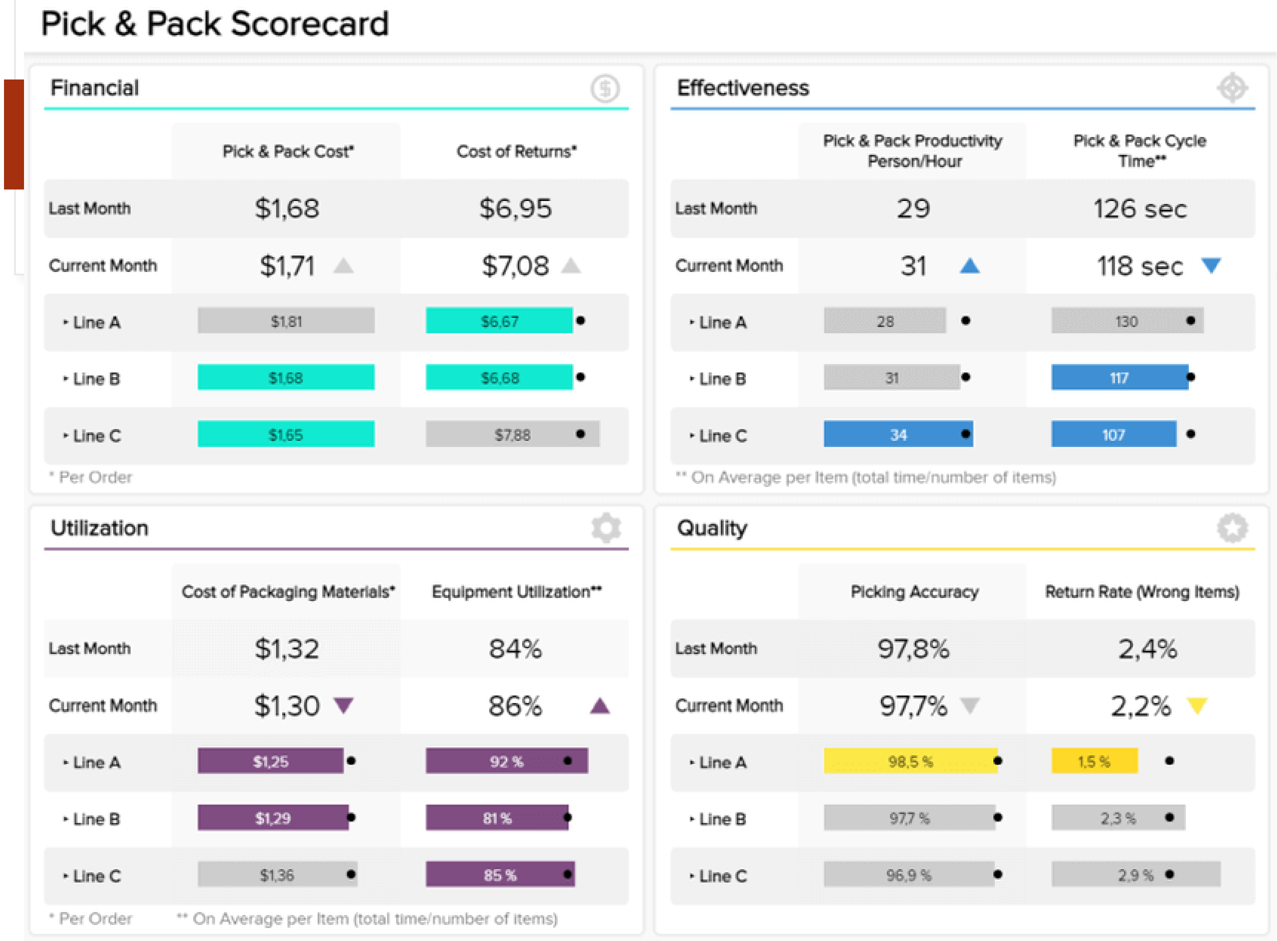

€ 67.619
TOTAL SPEND
vs. Total Budget
of € 105.000
€ 21.882
CAMPAIGN 1
vs. Budget
of € 25.000
€ 23.661
CAMPAIGN 2
vs. Budget
of € 30.000
€ 22.076
CAMPAIGN 3
vs. Budget
of € 50.000
71.680
TOTAL IMPRESSIONS
2.203
TOTAL CLICKS
106
TOTAL ACQUISITIONS
€ 631
COST PER ACQUISITION
CPA by Campaign - Last 12 weeks
Campaign 1
€419
Campaign 2
€1.118
Campaign 3
€678
Acquisitions by Campaign - Last 12 weeks
32
54
20
Daily Impressions by Campaign - Last 12 weeks
2016-01-21
2016-01-23
2016-01-25
2016-01-27
2016-01-29
2016-01-31
2016-02-02
2016-02-04
2016-02-06
2016-02-08
2016-02-10
2016-02-12
2016-02-14
2016-02-16
2016-02-18
2016-02-20
2016-02-22
2016-02-24
2016-02-26
2016-02-28
2016-03-01
2016-03-03
2016-03-05
2016-03-07
2016-03-09
2016-03-11
2016-03-13
2016-03-15
2016-03-17
2016-03-19
2016-03-21
2016-03-23
2016-03-25
2016-03-27
2016-03-29
2016-03-31
2016-04-02
2016-04-04
2016-04-06
2016-04-08
2016-04-10
2016-04-12

Marketing Operational KPI dashboard

- Monitoring for marketing department
- Performance of a campaign
- Any changes can immediately alert the team and operational activities can be adjusted.

Pick and pack operational dashboard for logistics

- Worker finds an item from an order in the warehouse and puts it in a box to be shipped to the customer.



Pick & Pack Scorecard

Financial

	Pick & Pack Cost*	Cost of Returns*
Last Month	$1,68	$6,95
Current Month	$1,71 ▲	$7,08 ▲
Line A	$1,81	$6,67
Line B	$1,68	$6,68
Line C	$1,65	$7,88

* Per Order

Effectiveness

	Pick & Pack Productivity Person/Hour	Pick & Pack Cycle Time**
Last Month	29	126 sec
Current Month	31 ▲	118 sec ▼
Line A	28	130
Line B	31	117
Line C	34	107

** On Average per Item (total time/number of items)

Utilization

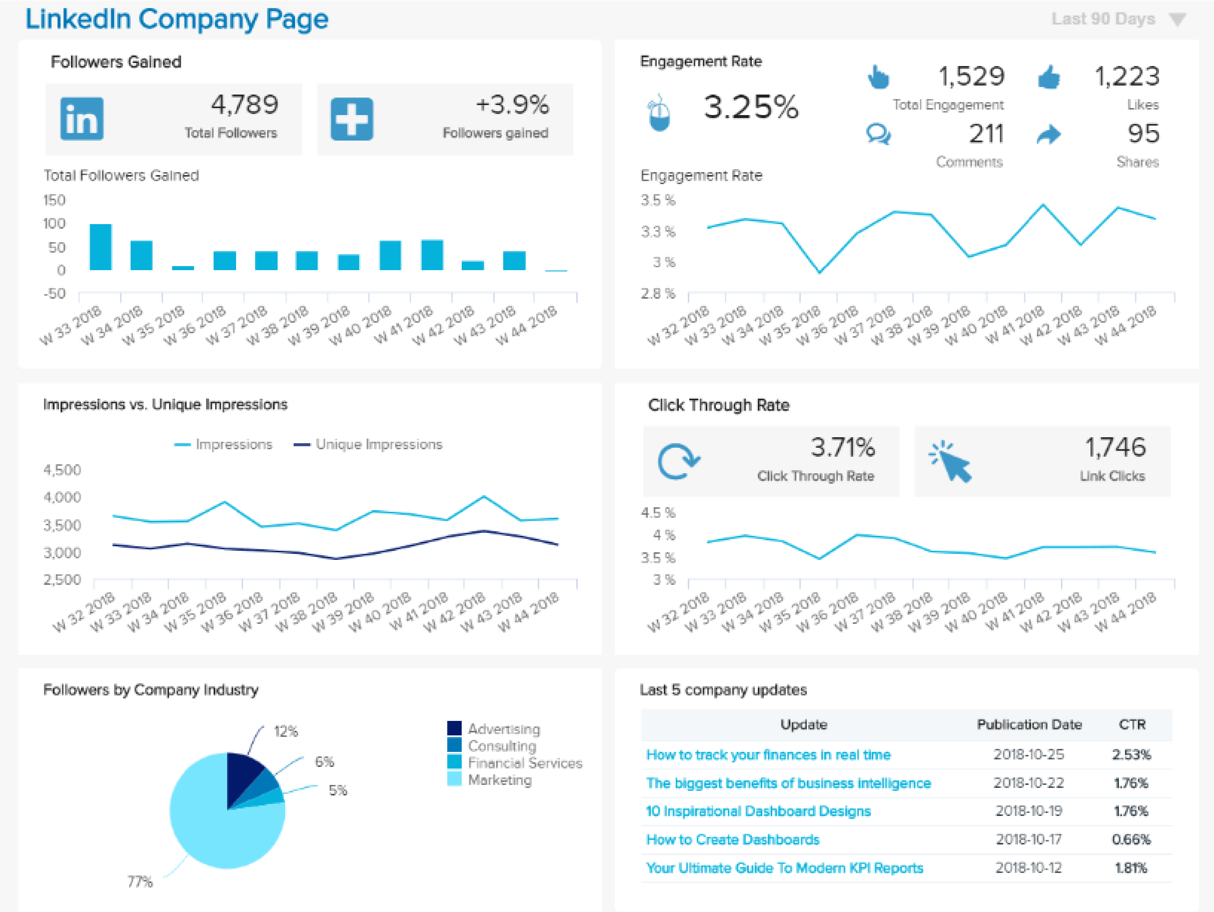
	Cost of Packaging Materials*	Equipment Utilization**
Last Month	$1,32	84%
Current Month	$1,30 ▼	86% ▲
Line A	$1,25	92 %
Line B	$1,29	81 %
Line C	$1,36	85 %

* Per Order   ** On Average per Item (total time/number of items)

Quality

	Picking Accuracy	Return Rate (Wrong Items)
Last Month	97,8%	2,4%
Current Month	97,7% ▼	2,2% ▼
Line A	98,5 %	1,5 %
Line B	97,7 %	2,3 %
Line C	96,9 %	2,9 %

LinkedIn operations dashboard


LinkedIn Company Page
Last 90 Days
Total Followers Gained
150
100
50
0
-50
W 33 2018
W 34 2018
W 35 2018
W 36 2018
W 37 2018
W 38 2018
W 39 2018
W 40 2018
W 41 2018
W 42 2018
W 43 2018
W 44 2018
Engagement Rate
3.5 %
3.3 %
3 %
2.8 %
W 32 2018
Impressions vs. Unique Impressions
Impressions
Unique Impressions
4,500
4,000
3,500
3,000
2,500
Click Through Rate
4.5 %
4 %
3.5 %
3 %
Followers by Company Industry
12%
6%
5%
77%
Advertising
Consulting
Financial Services
Marketing

Followers Gained

4,789 Total Followers

+3.9% Followers gained

Engagement Rate

3.25%

1,529 Total Engagement

1,223 Likes

211 Comments

95 Shares

Click Through Rate

3.71% Click Through Rate

1,746 Link Clicks

Last 5 company updates

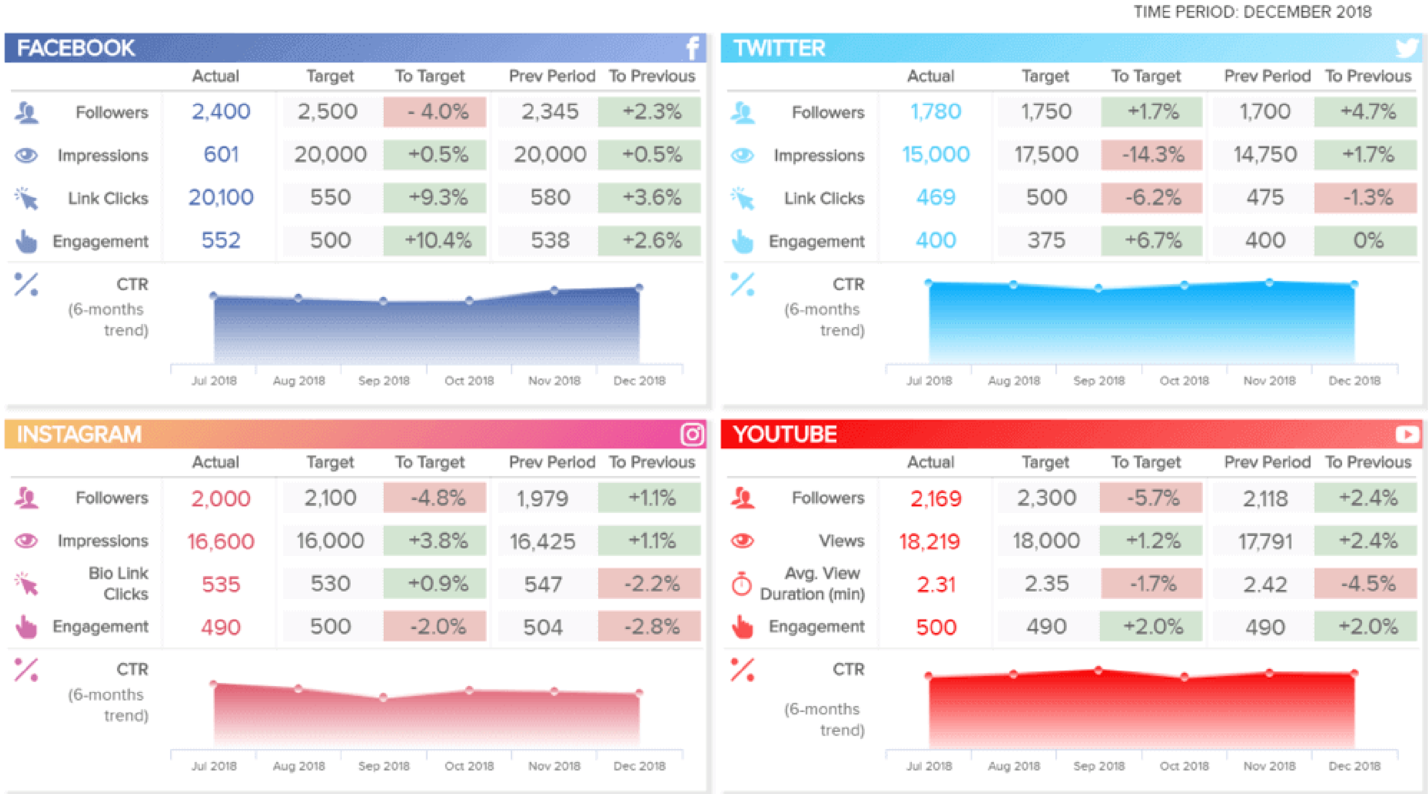
Update	Publication Date	CTR
How to track your finances in real time	2018-10-25	2.53%
The biggest benefits of business intelligence	2018-10-22	1.76%
10 Inspirational Dashboard Designs	2018-10-19	1.76%
How to Create Dashboards	2018-10-17	0.66%
Your Ultimate Guide To Modern KPI Reports	2018-10-12	1.81%

- To effectively **manage a company's presence,** companies can use an operational data dashboard that will solve multiple social media problems such as automation, customization of reports, and provide advanced data-driven features.

Tactical Dashboard

- Providing **analytical** recommendations for future strategies.
- Users: **Mid-level** management
- Monitoring processes supporting strategic initiatives
- Detail level falls between strategic and operational dashboards, incorporating more data visualization than operational dashboards.
- For example, a tactical sales dashboard tracks progress toward sales targets using various filters and customer segmentations, whereas an operational dashboard monitors real-time sales performance and compares it against competitors over time.

Social Media Tactical Dashboard



TIME PERIOD: DECEMBER 2018

FACEBOOK

	Actual	Target	To Target	Prev Period	To Previous
Followers	2,400	2,500	- 4.0%	2,345	+2.3%
Impressions	601	20,000	+0.5%	20,000	+0.5%
Link Clicks	20,100	550	+9.3%	580	+3.6%
Engagement	552	500	+10.4%	538	+2.6%

TWITTER

	Actual	Target	To Target	Prev Period	To Previous
Followers	1,780	1,750	+1.7%	1,700	+4.7%
Impressions	15,000	17,500	-14.3%	14,750	+1.7%
Link Clicks	469	500	-6.2%	475	-1.3%
Engagement	400	375	+6.7%	400	0%

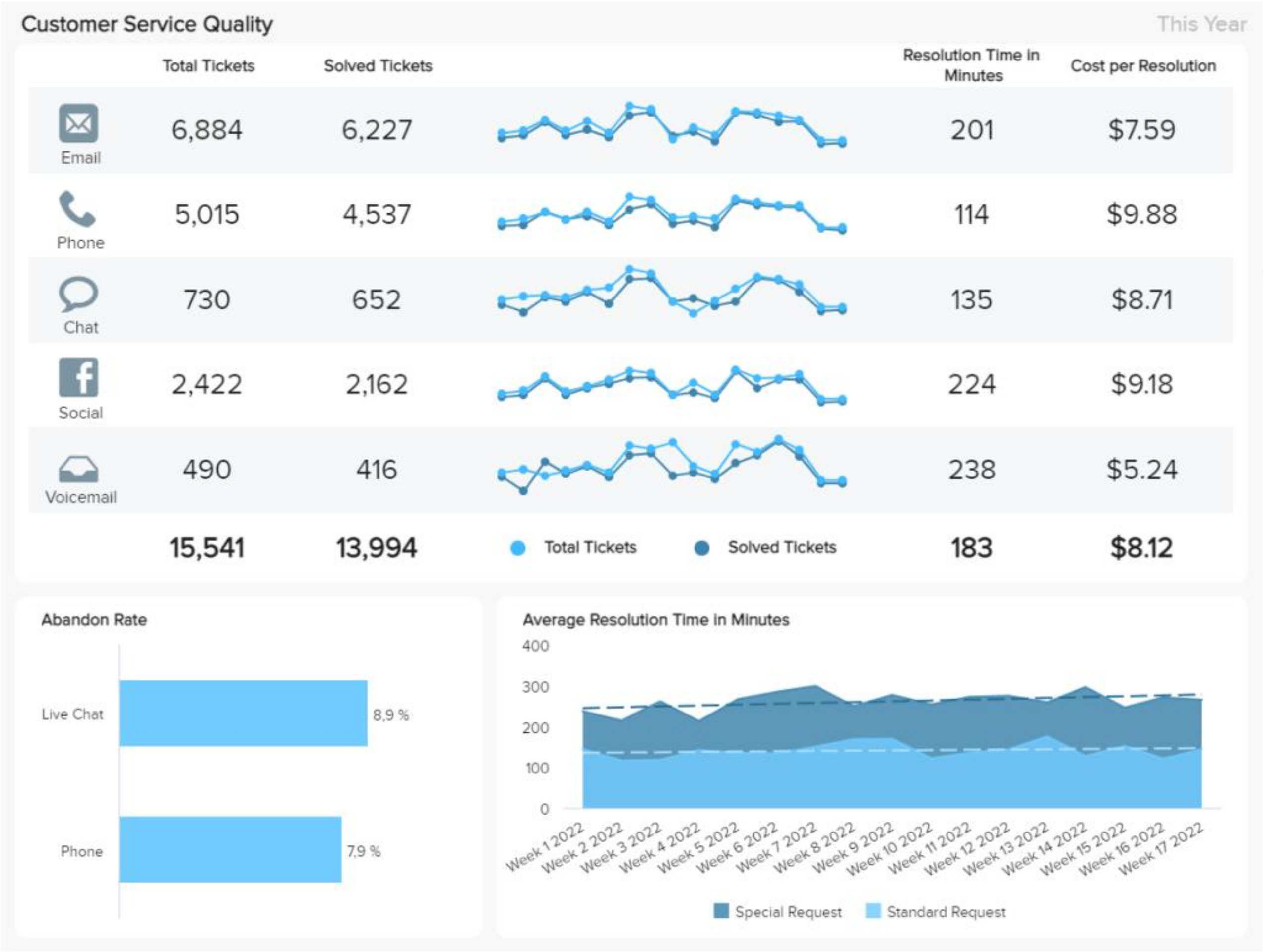
INSTAGRAM

	Actual	Target	To Target	Prev Period	To Previous
Followers	2,000	2,100	-4.8%	1,979	+1.1%
Impressions	16,600	16,000	+3.8%	16,425	+1.1%
Bio Link Clicks	535	530	+0.9%	547	-2.2%
Engagement	490	500	-2.0%	504	-2.8%

YOUTUBE

	Actual	Target	To Target	Prev Period	To Previous
Followers	2,169	2,300	-5.7%	2,118	+2.4%
Views	18,219	18,000	+1.2%	17,791	+2.4%
Avg. View Duration (min)	2.31	2.35	-1.7%	2.42	-4.5%
Engagement	500	490	+2.0%	490	+2.0%

- Tracking 4 main social media channels.
- Tactical Approach. Analysis of targets with additional comparisons



Customer Service Quality

This Year

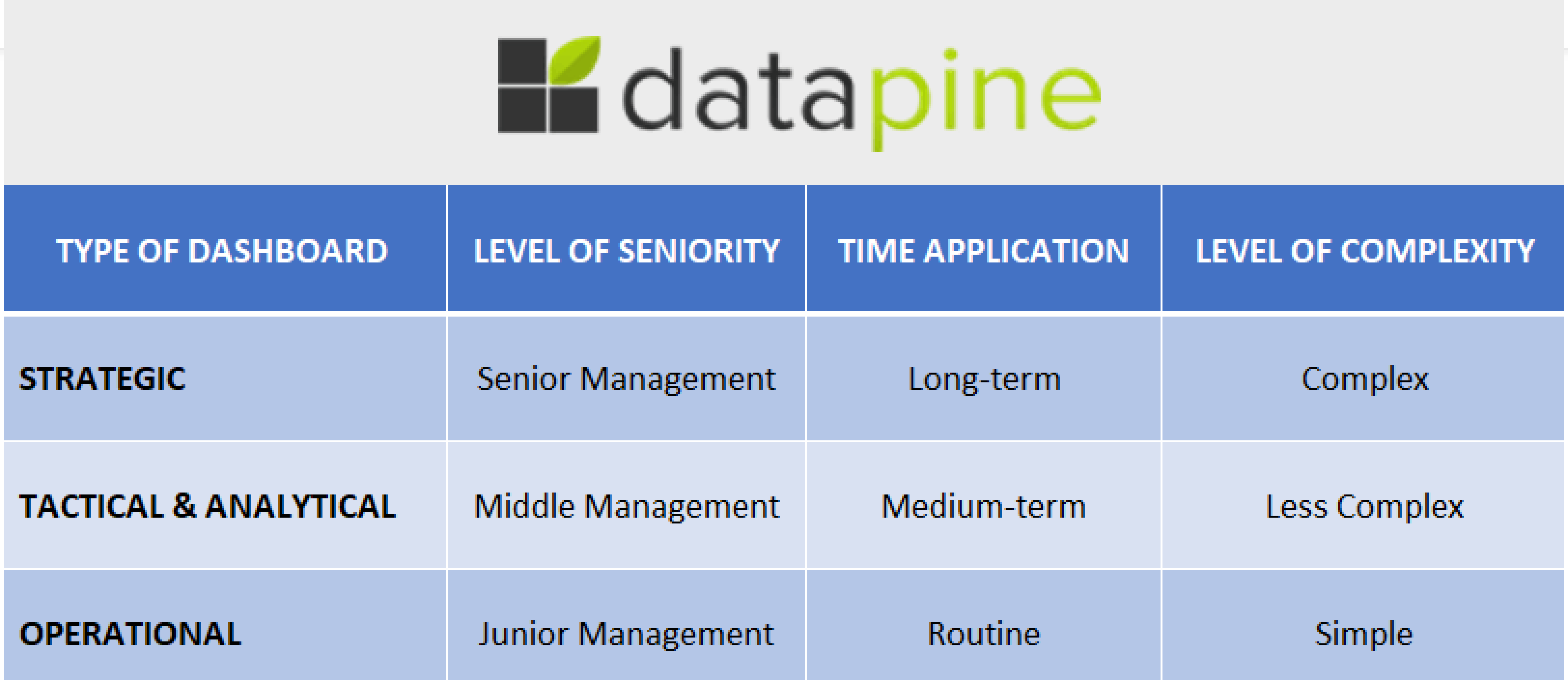
	Total Tickets	Solved Tickets		Resolution Time in Minutes	Cost per Resolution
Email	6,884	6,227		201	$7.59
Phone	5,015	4,537		114	$9.88
Chat	730	652		135	$8.71
Social	2,422	2,162		224	$9.18
Voicemail	490	416		238	$5.24
	15,541	**13,994**	● Total Tickets ● Solved Tickets	**183**	**$8.12**

Abandon Rate
Live Chat
8,9 %
Phone
7,9 %
Average Resolution Time in Minutes
400
300
200
100
0
Week 1 2022
Week 2 2022
Week 3 2022
Week 4 2022
Week 5 2022
Week 6 2022
Week 7 2022
Week 8 2022
Week 9 2022
Week 10 2022
Week 11 2022
Week 12 2022
Week 13 2022
Week 14 2022
Week 15 2022
Week 16 2022
Week 17 2022
Special Request
Standard Request

Customer Service Quality Dashboard

- Track key customer service metric and make tactical decisions to increase output and quality for most engaged consumer facing channels.

Comparison



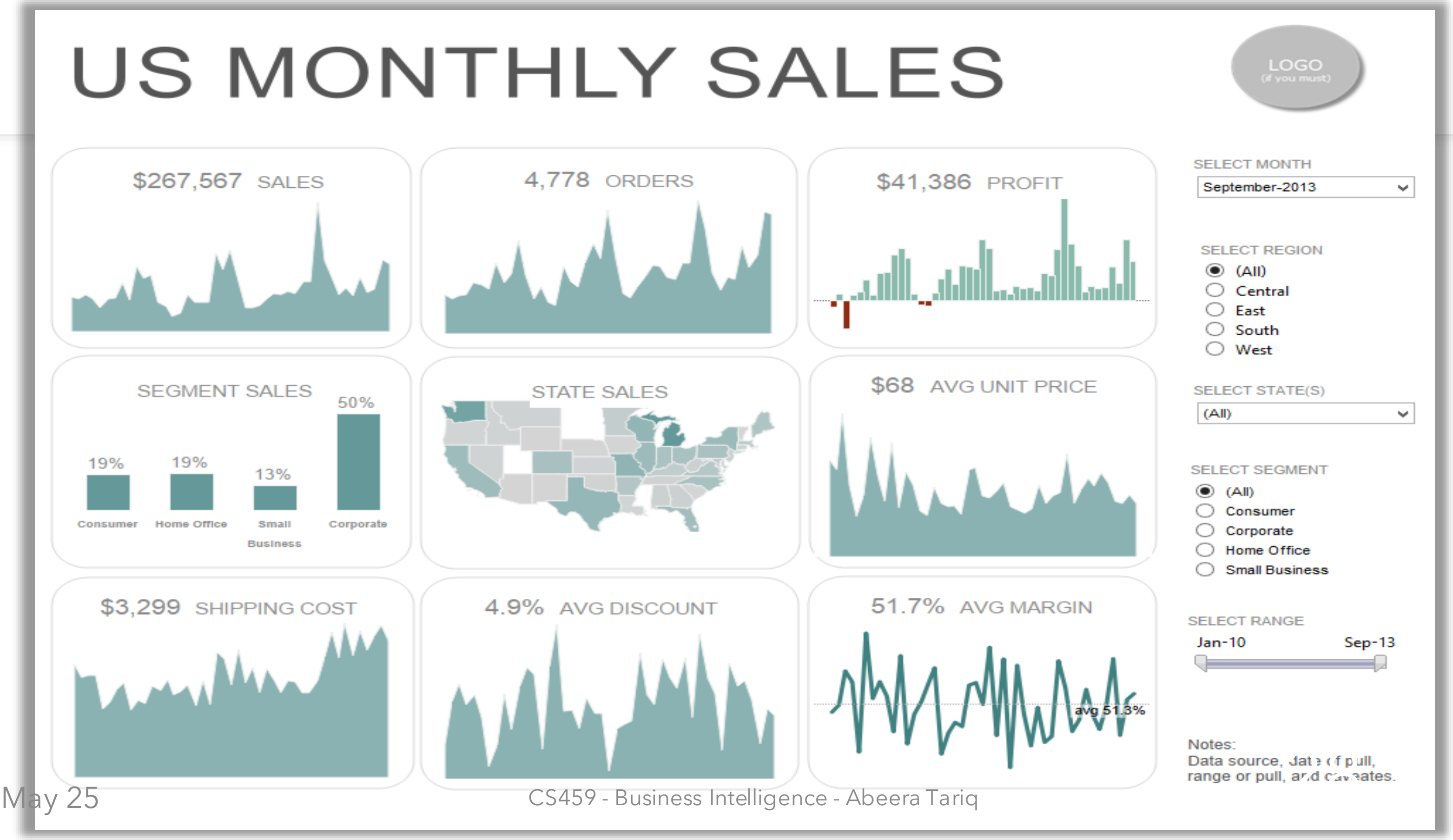
datapine

TYPE OF DASHBOARD	LEVEL OF SENIORITY	TIME APPLICATION	LEVEL OF COMPLEXITY
STRATEGIC	Senior Management	Long-term	Complex
TACTICAL & ANALYTICAL	Middle Management	Medium-term	Less Complex
OPERATIONAL	Junior Management	Routine	Simple

Examples

Good or Bad Dashboards

Good Dashboards – Too many charts but organized


US MONTHLY SALES
LOGO
(if you must)
$267,567 SALES
4,778 ORDERS
$41,386 PROFIT
SEGMENT SALES
19%
19%
13%
50%
Consumer
Home Office
Small Business
Corporate
STATE SALES
$68 AVG UNIT PRICE
$3,299 SHIPPING COST
4.9% AVG DISCOUNT
51.7% AVG MARGIN
avg 51.3%

SELECT MONTH
September-2013

SELECT REGION
- ● (All)
- ○ Central
- ○ East
- ○ South
- ○ West

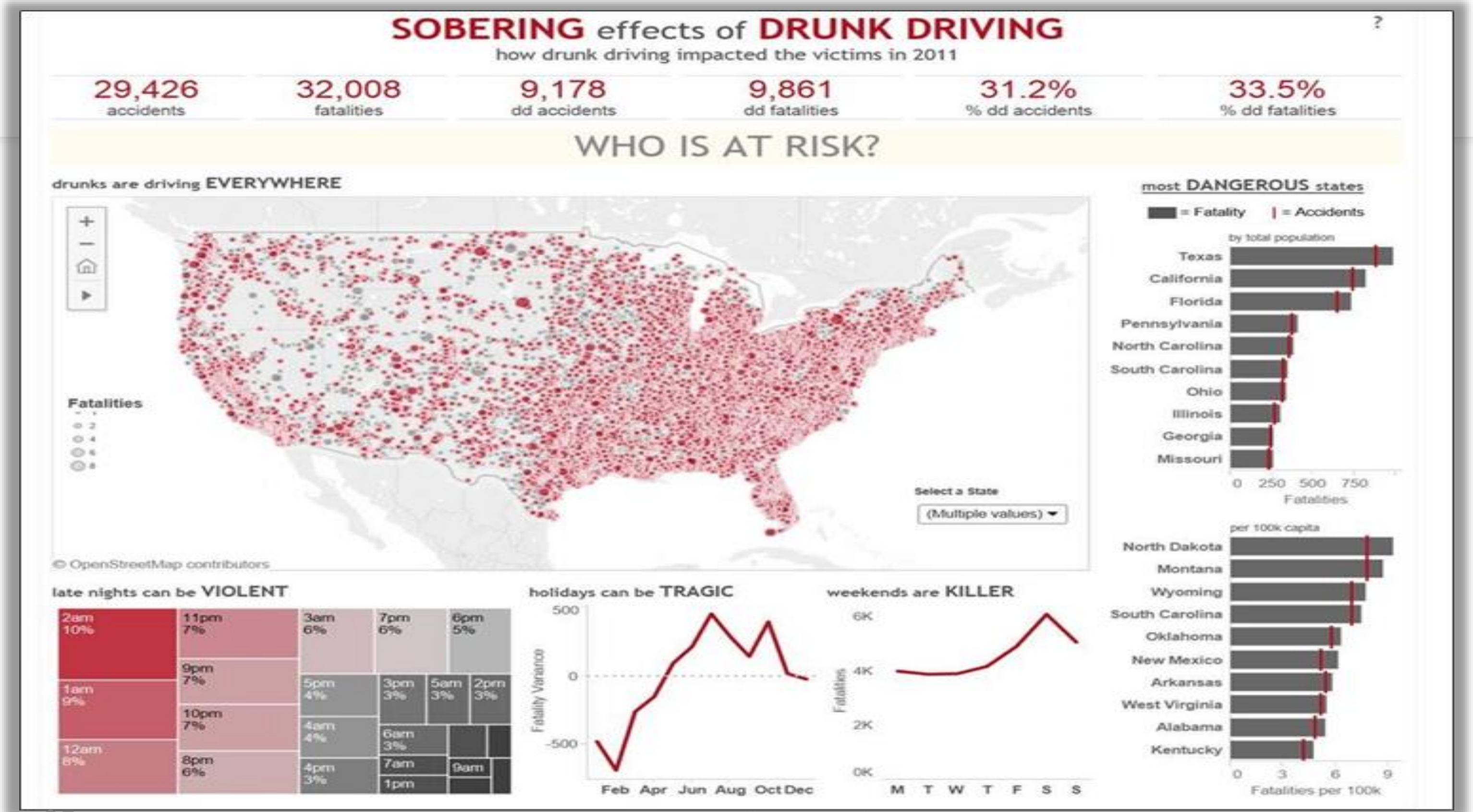
SELECT STATE(S)
(All)

SELECT SEGMENT
- ● (All)
- ○ Consumer
- ○ Corporate
- ○ Home Office
- ○ Small Business

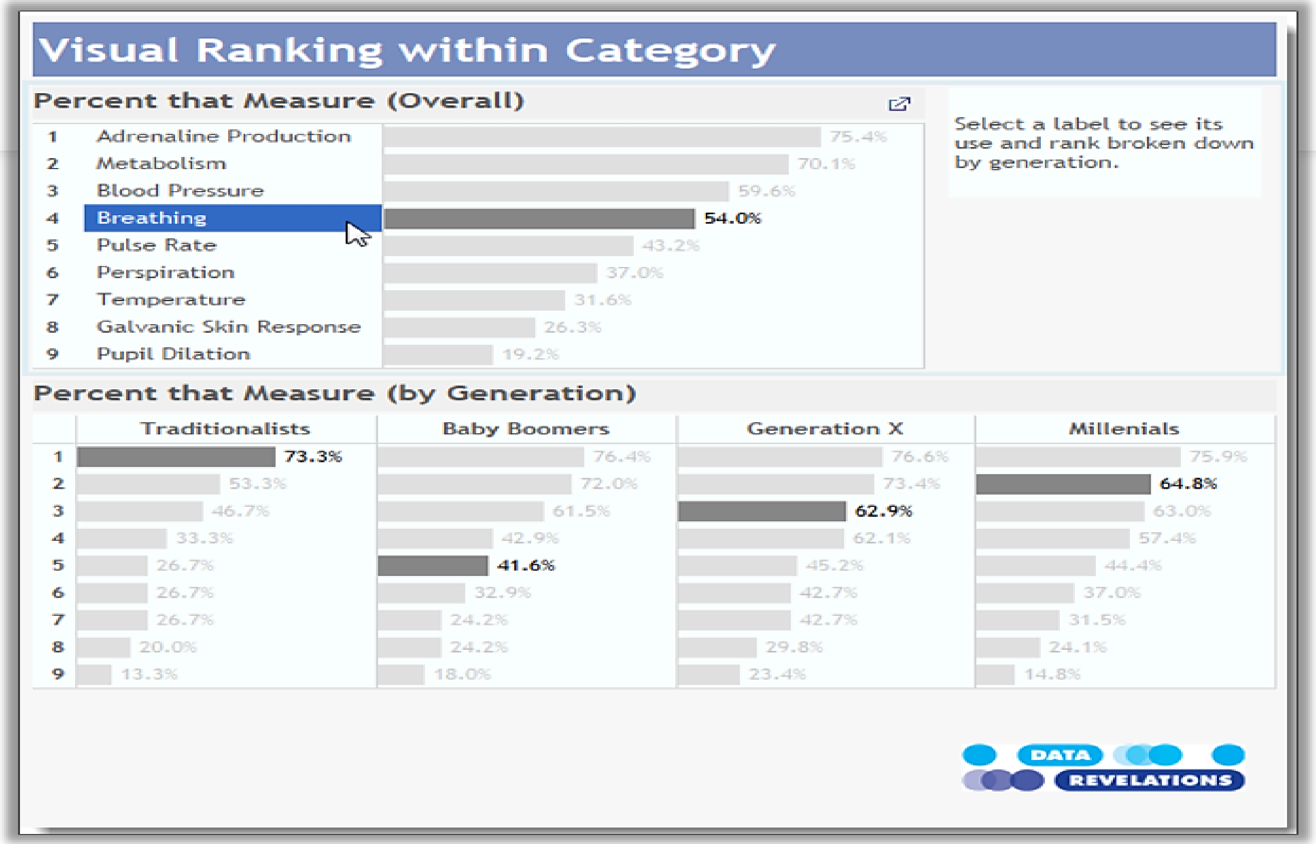
SELECT RANGE
Jan-10 Sep-13

Notes:
Data source, date of pull,
range or pull, and caveats.

Good Dashboards – Map is the center of attention


SOBERING effects of DRUNK DRIVING
how drunk driving impacted the victims in 2011
29,426 accidents
32,008 fatalities
9,178 dd accidents
9,861 dd fatalities
31.2% % dd accidents
33.5% % dd fatalities
WHO IS AT RISK?
drunks are driving EVERYWHERE
Fatalities
2
4
6
8
Select a State
(Multiple values)
© OpenStreetMap contributors
most DANGEROUS states
= Fatality
= Accidents
by total population
Texas
California
Florida
Pennsylvania
North Carolina
South Carolina
Ohio
Illinois
Georgia
Missouri
0 250 500 750
Fatalities
per 100k capita
North Dakota
Montana
Wyoming
South Carolina
Oklahoma
New Mexico
Arkansas
West Virginia
Alabama
Kentucky
0 3 6 9
Fatalities per 100k
late nights can be VIOLENT
2am 10%
1am 9%
12am 8%
11pm 7%
9pm 7%
10pm 7%
8pm 6%
3am 6%
7pm 6%
6pm 5%
5pm 4%
3pm 3%
5am 3%
2pm 3%
4am 4%
6am 3%
4pm 3%
7am
9am
1pm
holidays can be TRAGIC
500
0
-500
Fatality Variance
Feb Apr Jun Aug Oct Dec
weekends are KILLER
6K
4K
2K
0K
Fatalities
M T W T F S S

Good Dashboards – All bars but meaningful information



Visual Ranking within Category

Percent that Measure (Overall)

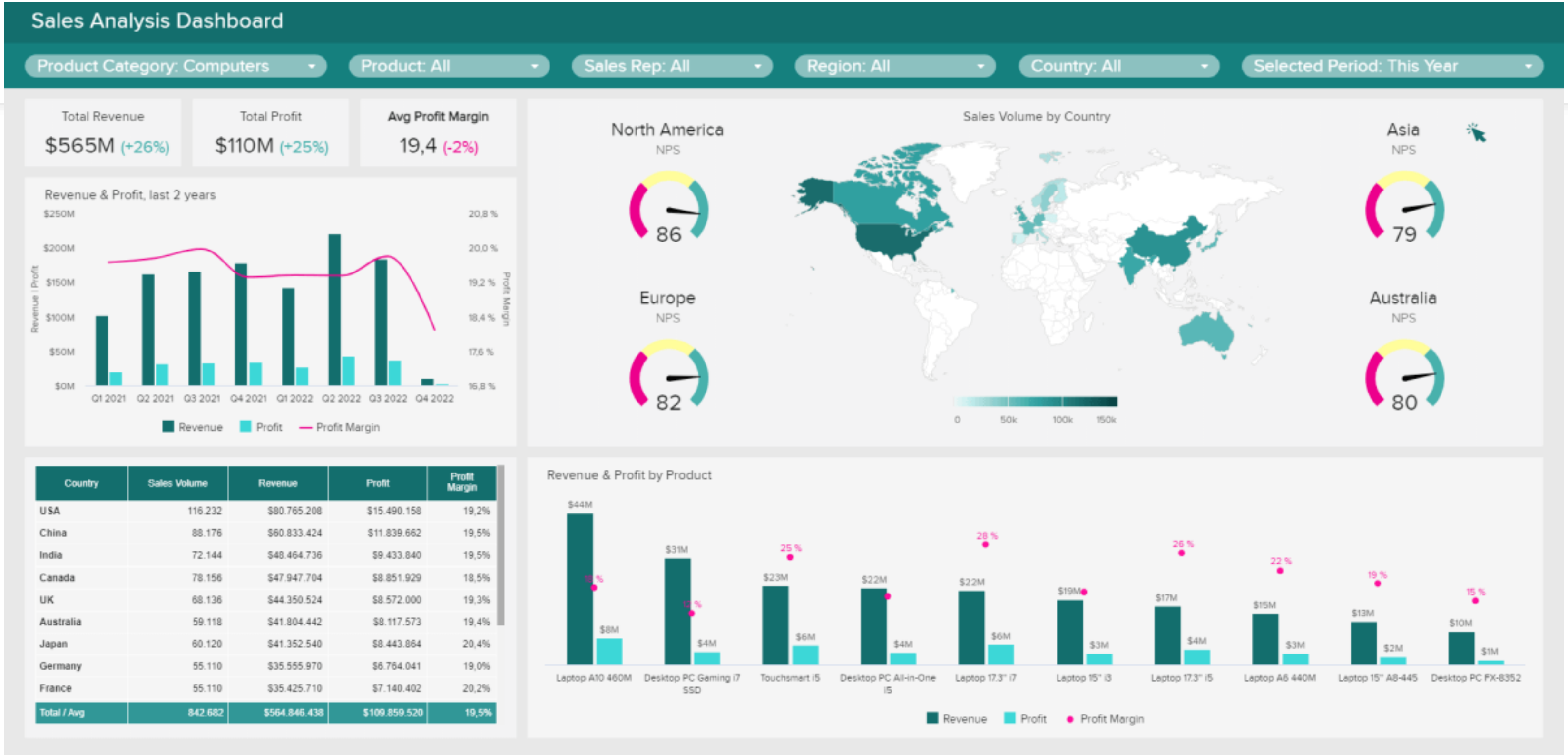
1	Adrenaline Production	75.4%
2	Metabolism	70.1%
3	Blood Pressure	59.6%
4	Breathing	54.0%
5	Pulse Rate	43.2%
6	Perspiration	37.0%
7	Temperature	31.6%
8	Galvanic Skin Response	26.3%
9	Pupil Dilation	19.2%

Select a label to see its use and rank broken down by generation.

Percent that Measure (by Generation)

	Traditionalists	Baby Boomers	Generation X	Millenials
1	73.3%	76.4%	76.6%	75.9%
2	53.3%	72.0%	73.4%	64.8%
3	46.7%	61.5%	62.9%	63.0%
4	33.3%	42.9%	62.1%	57.4%
5	26.7%	41.6%	45.2%	44.4%
6	26.7%	32.9%	42.7%	37.0%
7	26.7%	24.2%	42.7%	31.5%
8	20.0%	24.2%	29.8%	24.1%
9	13.3%	18.0%	23.4%	14.8%

Good Dashboards – KPIs, Filters, colors



Sales Analysis Dashboard

Product Category: Computers ▾ | Product: All ▾ | Sales Rep: All ▾ | Region: All ▾ | Country: All ▾ | Selected Period: This Year ▾

Total Revenue
$565M (+26%)

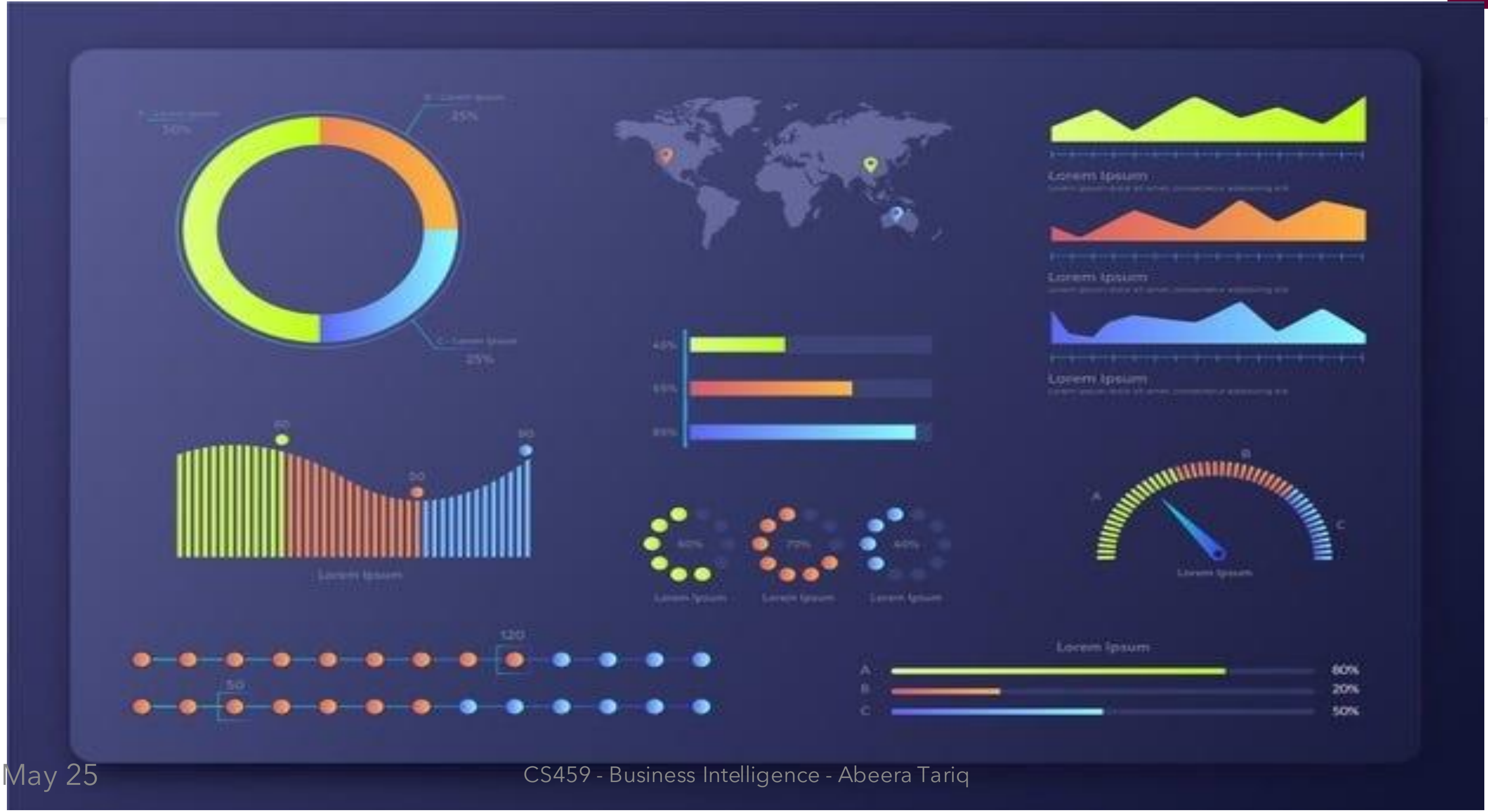
Total Profit
$110M (+25%)

Avg Profit Margin
19,4 (-2%)

Country	Sales Volume	Revenue	Profit	Profit Margin
USA	116.232	$80.765.208	$15.490.158	19,2%
China	88.176	$60.833.424	$11.839.662	19,5%
India	72.144	$48.464.736	$9.433.840	19,5%
Canada	78.156	$47.947.704	$8.851.929	18,5%
UK	68.136	$44.350.524	$8.572.000	19,3%
Australia	59.118	$41.804.442	$8.117.573	19,4%
Japan	60.120	$41.352.540	$8.443.864	20,4%
Germany	55.110	$35.555.970	$6.764.041	19,0%
France	55.110	$35.425.710	$7.140.402	20,2%
Total / Avg	842.682	$564.846.438	$109.859.520	19,5%

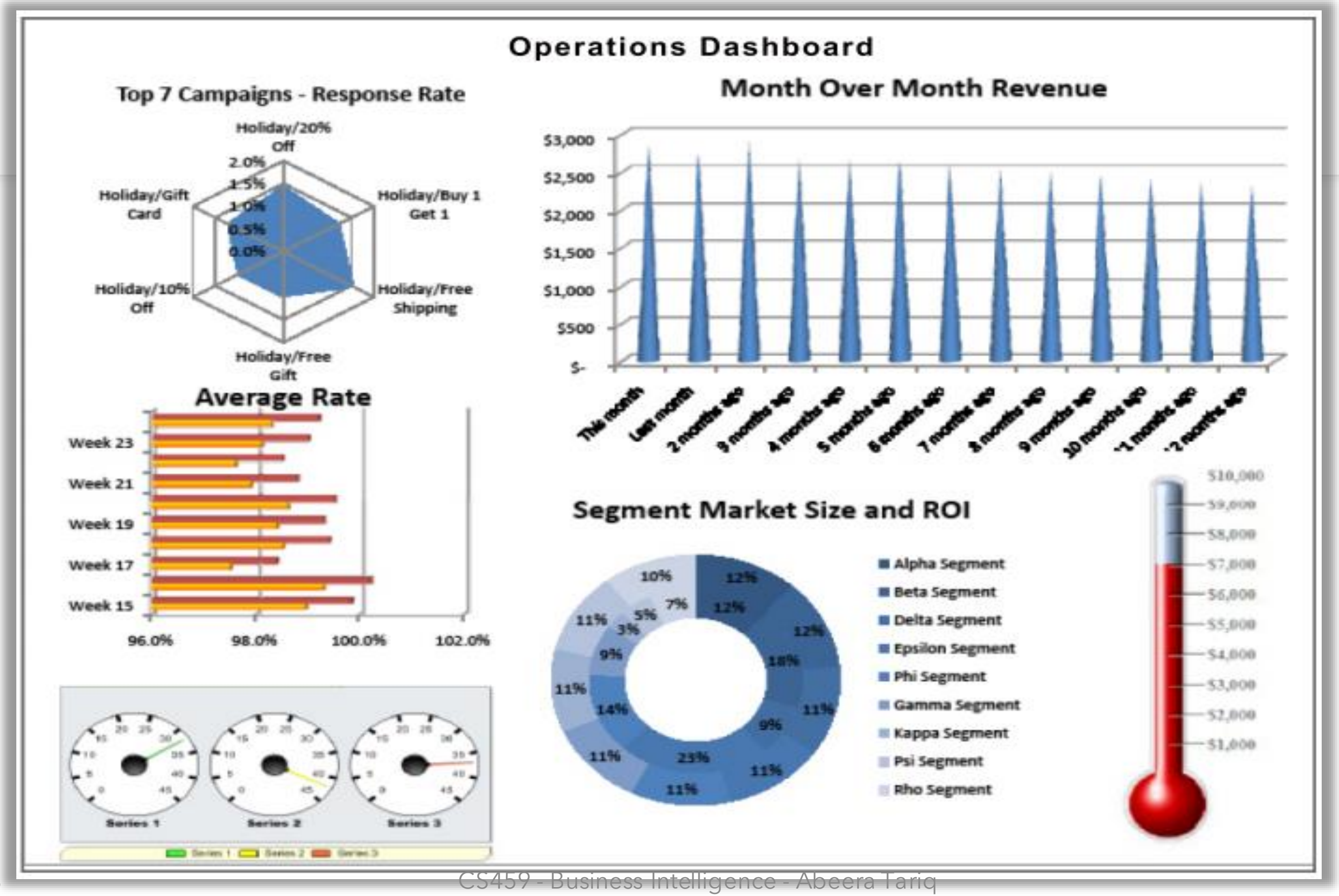
Revenue & Profit, last 2 years
$250M
$200M
$150M
$100M
$50M
$0M
Revenue | Profit
20,8 %
20,0 %
19,2 %
18,4 %
17,6 %
16,8 %
Profit Margin
Q1 2021
Q2 2021
Q3 2021
Q4 2021
Q1 2022
Q2 2022
Q3 2022
Q4 2022
Revenue
Profit
Profit Margin
North America
NPS
86
Europe
NPS
82
Sales Volume by Country
0
50k
100k
150k
Asia
NPS
79
Australia
NPS
80
Revenue & Profit by Product
$44M
$8M
18 %
Laptop A10 460M
$31M
$4M
12 %
Desktop PC Gaming i7 SSD
$23M
$6M
25 %
Touchsmart i5
$22M
$4M
Desktop PC All-in-One i5
$22M
$6M
28 %
Laptop 17.3" i7
$19M
$3M
Laptop 15" i3
$17M
$4M
26 %
Laptop 17.3" i5
$15M
$3M
22 %
Laptop A6 440M
$13M
$2M
19 %
Laptop 15" A8-445
$10M
$1M
15 %
Desktop PC FX-8352
Revenue
Profit
Profit Margin

Good Dashboards - Choice of Colors

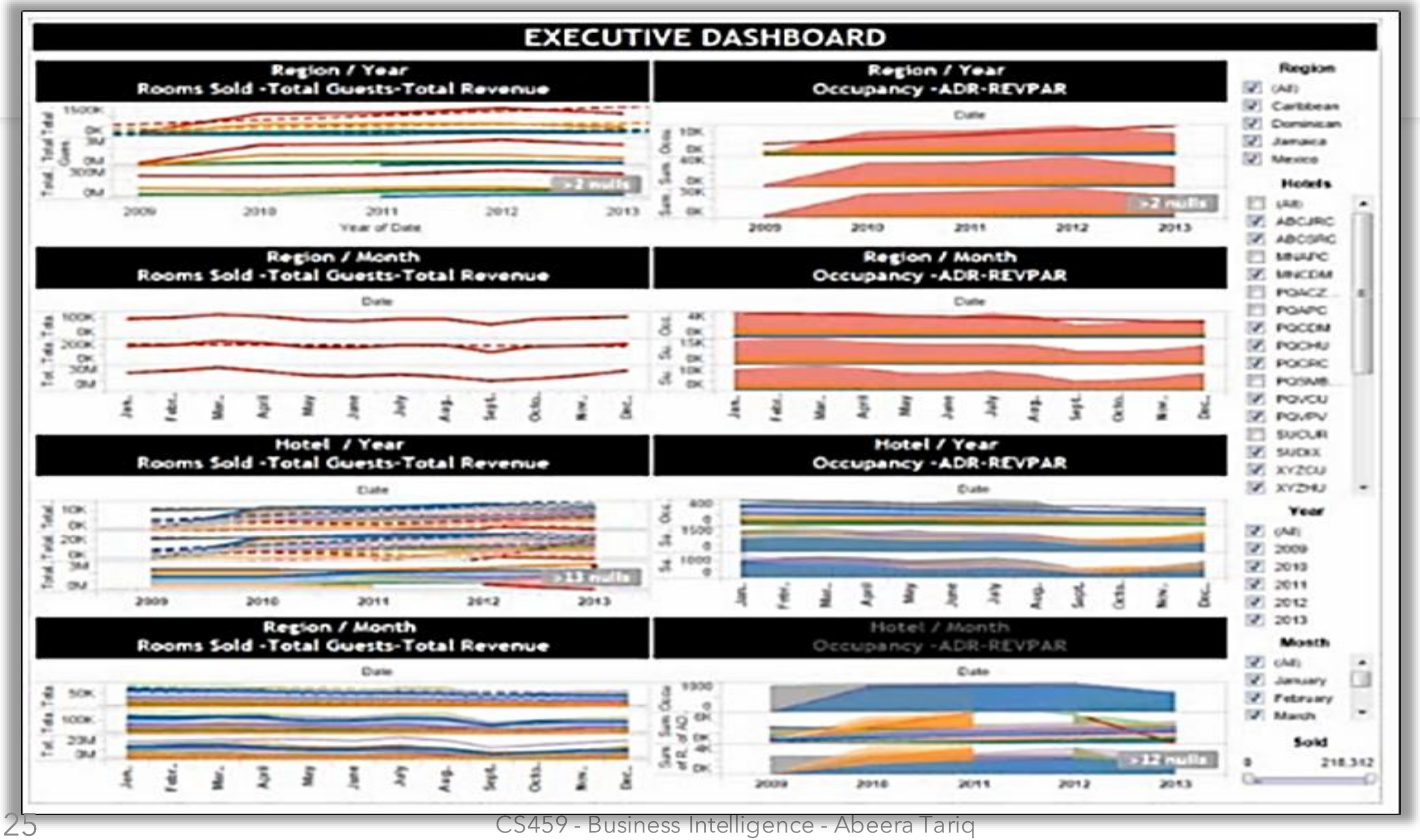

Lorem Ipsum
Lorem Ipsum
Lorem Ipsum
Lorem Ipsum
120
50
Lorem Ipsum
A
B
C
60%
20%
50%

What not to do…

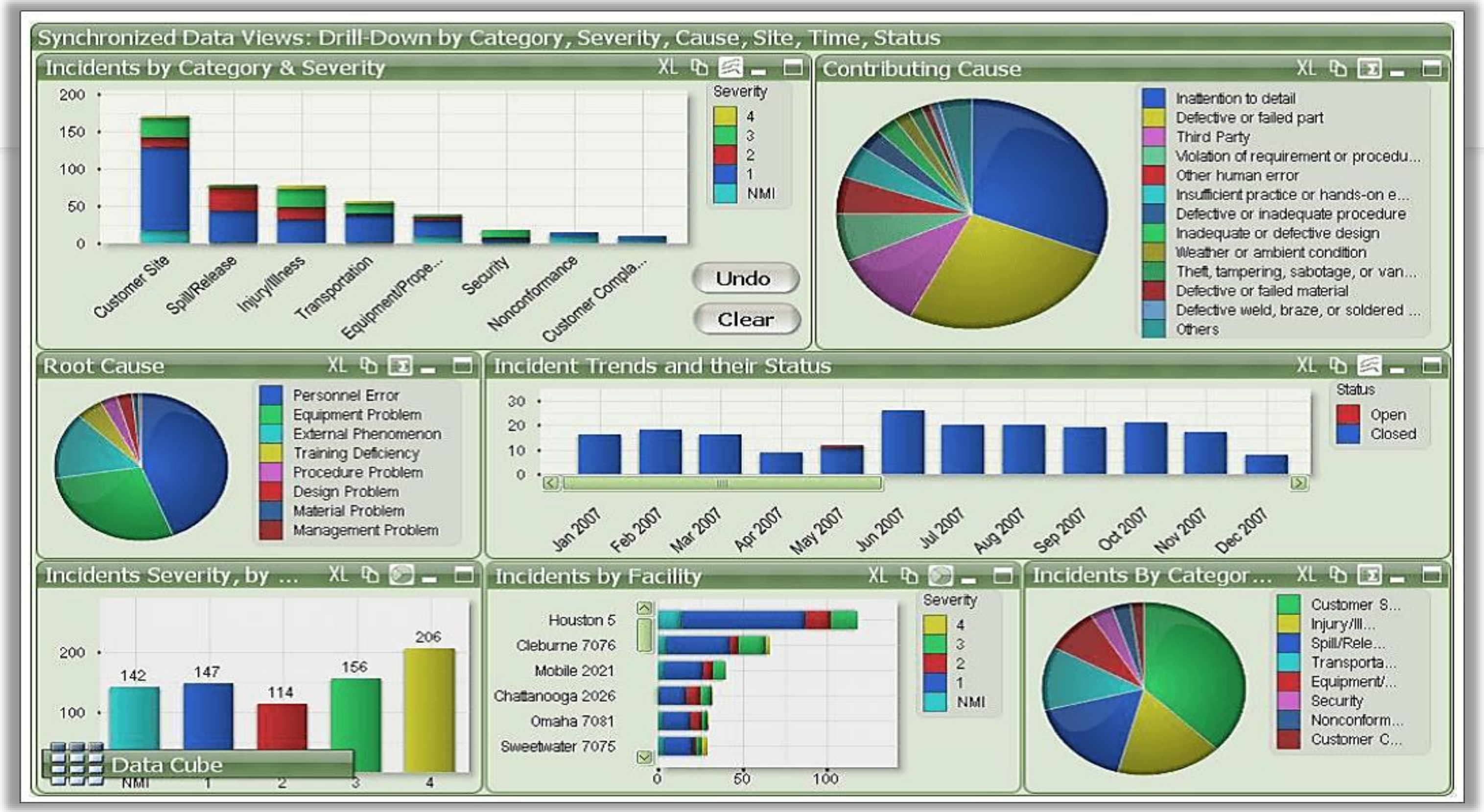
Bad Dashboards



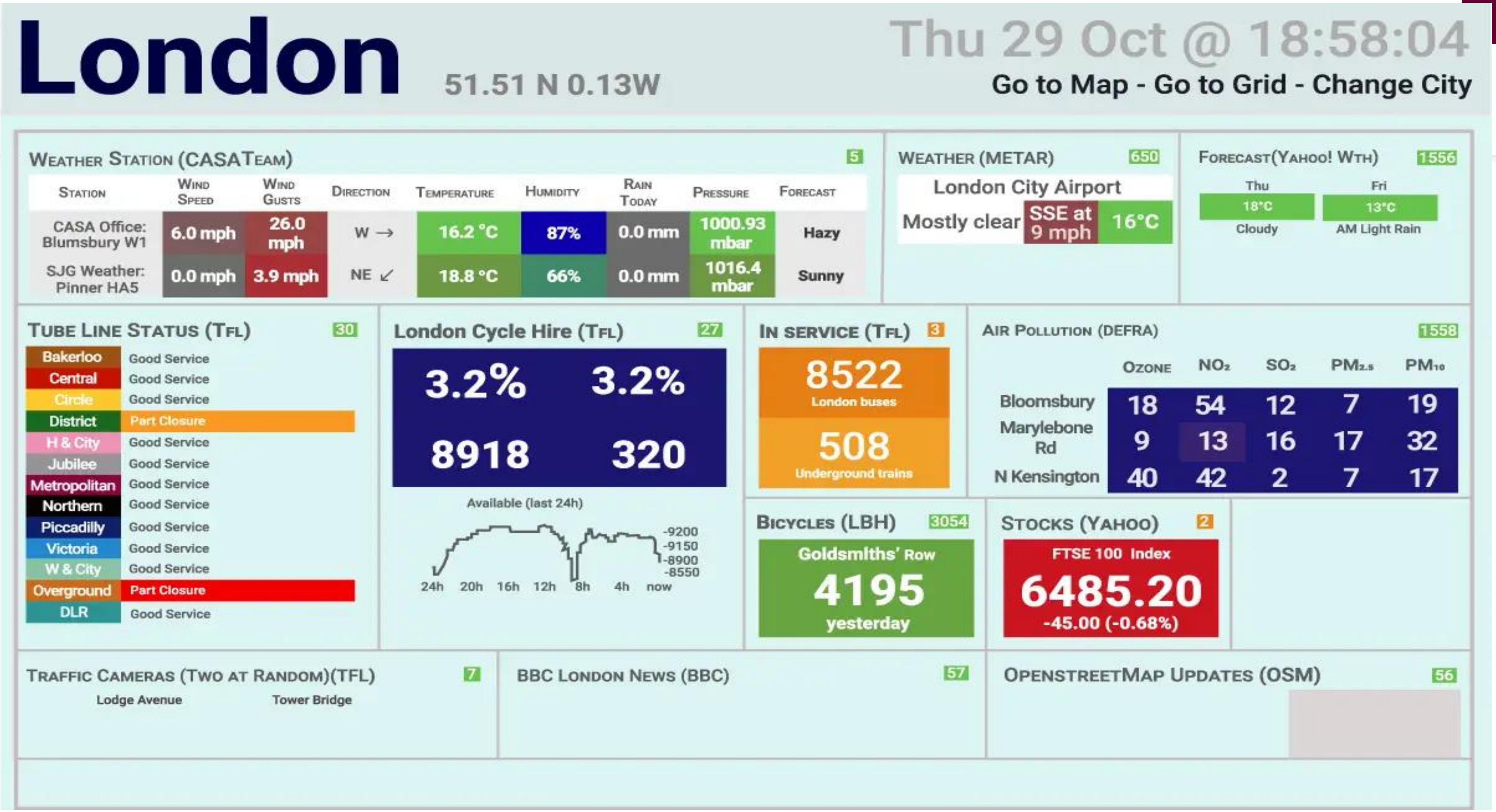
Bad Dashboards


EXECUTIVE DASHBOARD
Region / Year
Rooms Sold -Total Guests-Total Revenue
Region / Year
Occupancy -ADR-REVPAR
Region / Month
Rooms Sold -Total Guests-Total Revenue
Region / Month
Occupancy -ADR-REVPAR
Hotel / Year
Rooms Sold -Total Guests-Total Revenue
Hotel / Year
Occupancy -ADR-REVPAR
Region / Month
Rooms Sold -Total Guests-Total Revenue
Hotel / Month
Occupancy -ADR-REVPAR
Year of Date
Date
2009
2010
2011
2012
2013
Jan.
Febr.
Mar.
April
May
June
July
Aug.
Sept.
Octo.
Nov.
Dec.
>2 nulls
>13 nulls
>12 nulls
Region
☑ (All)
☑ Caribbean
☑ Dominican
☑ Jamaica
☑ Mexico
Hotels
☐ (All)
☑ ABCJRC
☑ ABCSRC
☐ MNAPC
☑ MNCDM
☐ POACZ..
☐ POAPC
☑ POCDM
☑ POCHU
☑ POCRC
☐ POSMB
☑ POVCU
☑ POVPV
☐ SUCUR
☑ SUDXX
☑ XYZCU
☑ XYZHU
Year
☑ (All)
☑ 2009
☑ 2010
☑ 2011
☑ 2012
☑ 2013
Month
☑ (All)
☑ January
☑ February
☑ March
Sold
0
218,312

Bad Dashboards


Synchronized Data Views: Drill-Down by Category, Severity, Cause, Site, Time, Status
Incidents by Category & Severity
200
150
100
50
0
Customer Site
Spill/Release
Injury/Illness
Transportation
Equipment/Prope...
Security
Nonconformance
Customer Compla...
Severity
4
3
2
1
NMI
Undo
Clear
Contributing Cause
Inattention to detail
Defective or failed part
Third Party
Violation of requirement or procedu...
Other human error
Insufficient practice or hands-on e...
Defective or inadequate procedure
Inadequate or defective design
Weather or ambient condition
Theft, tampering, sabotage, or van...
Defective or failed material
Defective weld, braze, or soldered ...
Others
Root Cause
Personnel Error
Equipment Problem
External Phenomenon
Training Deficiency
Procedure Problem
Design Problem
Material Problem
Management Problem
Incident Trends and their Status
30
20
10
0
Jan 2007
Feb 2007
Mar 2007
Apr 2007
May 2007
Jun 2007
Jul 2007
Aug 2007
Sep 2007
Oct 2007
Nov 2007
Dec 2007
Status
Open
Closed
Incidents Severity, by ...
200
100
142
147
114
156
206
NMI
1
2
3
4
Data Cube
Incidents by Facility
Houston 5
Cleburne 7076
Mobile 2021
Chattanooga 2026
Omaha 7081
Sweetwater 7075
0
50
100
Severity
4
3
2
1
NMI
Incidents By Categor...
Customer S...
Injury/Ill...
Spill/Rele...
Transporta...
Equipment/...
Security
Nonconform...
Customer C...
XL

Bad Dashboards



London 51.51 N 0.13W

Thu 29 Oct @ 18:58:04

Go to Map - Go to Grid - Change City

Weather Station (CASATeam) 5

Station	Wind Speed	Wind Gusts	Direction	Temperature	Humidity	Rain Today	Pressure	Forecast
CASA Office: Blumsbury W1	6.0 mph	26.0 mph	W →	16.2 °C	87%	0.0 mm	1000.93 mbar	Hazy
SJG Weather: Pinner HA5	0.0 mph	3.9 mph	NE ↙	18.8 °C	66%	0.0 mm	1016.4 mbar	Sunny

Weather (METAR) 650

London City Airport

Mostly clear | SSE at 9 mph | 16°C

Forecast(Yahoo! Wth) 1556

Thu	Fri
18°C	13°C
Cloudy	AM Light Rain

Tube Line Status (TfL) 30

Bakerloo	Good Service
Central	Good Service
Circle	Good Service
District	Part Closure
H & City	Good Service
Jubilee	Good Service
Metropolitan	Good Service
Northern	Good Service
Piccadilly	Good Service
Victoria	Good Service
W & City	Good Service
Overground	Part Closure
DLR	Good Service

London Cycle Hire (TfL) 27

3.2%	3.2%
8918	320

Available (last 24h)

In service (TfL) 3

8522
London buses

508
Underground trains

Air Pollution (DEFRA) 1558

	Ozone	NO₂	SO₂	PM2.5	PM10
Bloomsbury	18	54	12	7	19
Marylebone Rd	9	13	16	17	32
N Kensington	40	42	2	7	17

Bicycles (LBH) 3054

Goldsmiths' Row
4195
yesterday

Stocks (Yahoo) 2

FTSE 100 Index
6485.20
-45.00 (-0.68%)

Traffic Cameras (Two at Random)(TfL) 7

Lodge Avenue

Tower Bridge

BBC London News (BBC) 57

OpenStreetMap Updates (OSM) 56

Best Practices - Effective Dashboards

1. Identify your **goal**
2. Design for the real world
3. Choose metrics that matter
4. Keep it visual
5. Build in functionality
6. Avoid chart junk
7. Follow the 4 C's of Visualization
8. Finalize with Tableau's dashboard checklist

1. Identify your goal

- Know your purpose and audience/consumer
- Know your dashboard type
  - Strategic: executive, high-level
  - Operational: immediate use, sales information, pulse
  - Analytic/Tactical: drill-down, highly interactive
- What value will the dashboard add?
  - ...help management define what is important?
  - ...educate people in the organization about the things that matter?
  - ...set goals and expectations for specific individuals or groups?
  - ...help executives sleep at night because they know what's going on?
  - ...encourage specific actions in a timely manner?
  - ...highlight exceptions and provide alerts when problems occur?
  - ...communicate progress and success?
  - ...provide a common interface for interacting with and analyzing important business data?
- Leverage the most viewed spot

2. Design for the real world

- Author at your final display size
- Limit the number of views to three or four (unless there is an absolute need)
- Implement an iterative improvement process based on user feedback

3. Choose metrics that matter

- Metrics must be relevant to the goal.
- Ask the following questions when deciding which metrics to include in your dashboard:
  1. How does each metric contribute to those **objectives**?
  2. Do you have data, either internal or external, that can shed light on the objectives?
  3. Can you design a meaningful metric that measures those contributions?
  4. Is this metric truly necessary to contribute to the objectives?
  5. Can you build a systematic and on-going means of measurement?

4. Keep it visual

- Cognition & Visual Perception
- Gestalt Theory (the whole of anything is greater than its parts)
  - Color choice
  - Design for Accessibility: avoid red-green and 'stop light' palette (red-yellow-green)
  - Stay on-brand and on-theme (online color palette tools make this easy)
  - Font choice
  - Chart choice
  - White space
  - Information grouping
  - Most important data on X and Y axes; encode less important data in color or shape attributes
- Pre-Attentive Attributes / Enduring Dispositions
- Make it easy for your audience to understand your message

Cognition & Visual Perception

- Vision is among our keenest senses
- Our brains process visual information faster and more efficiently than text
- Our visual system has been processing information long before language was ever developed

Chart v Tabular data presentation – which do you prefer?

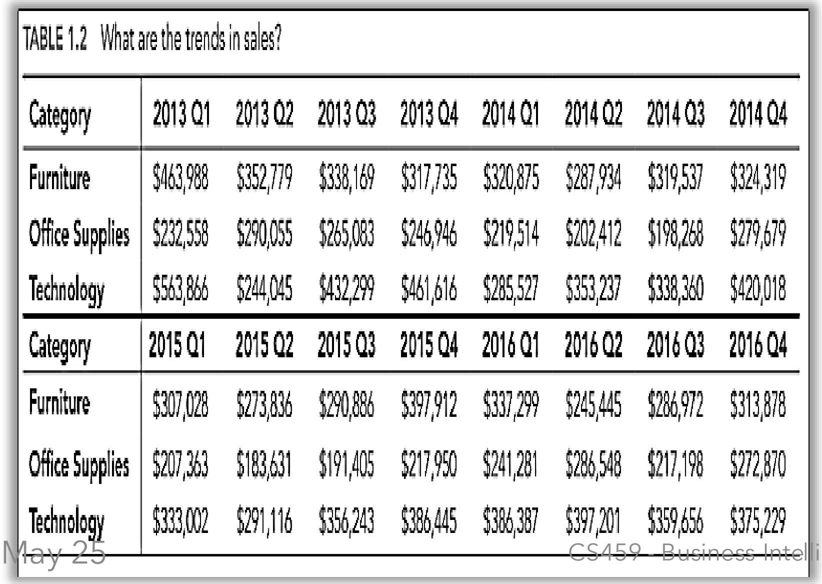


TABLE 1.2 What are the trends in sales?

Category	2013 Q1	2013 Q2	2013 Q3	2013 Q4	2014 Q1	2014 Q2	2014 Q3	2014 Q4
Furniture	$463,988	$352,779	$338,169	$317,735	$320,875	$287,934	$319,537	$324,319
Office Supplies	$232,558	$290,055	$265,083	$246,946	$219,514	$202,412	$198,268	$279,679
Technology	$563,866	$244,045	$432,299	$461,616	$285,527	$353,237	$338,360	$420,018
Category	**2015 Q1**	**2015 Q2**	**2015 Q3**	**2015 Q4**	**2016 Q1**	**2016 Q2**	**2016 Q3**	**2016 Q4**
Furniture	$307,028	$273,836	$290,886	$397,912	$337,299	$245,445	$286,972	$313,878
Office Supplies	$207,363	$183,631	$191,405	$217,950	$241,281	$286,548	$217,198	$272,870
Technology	$333,002	$291,116	$356,243	$386,445	$386,387	$397,201	$359,656	$375,229

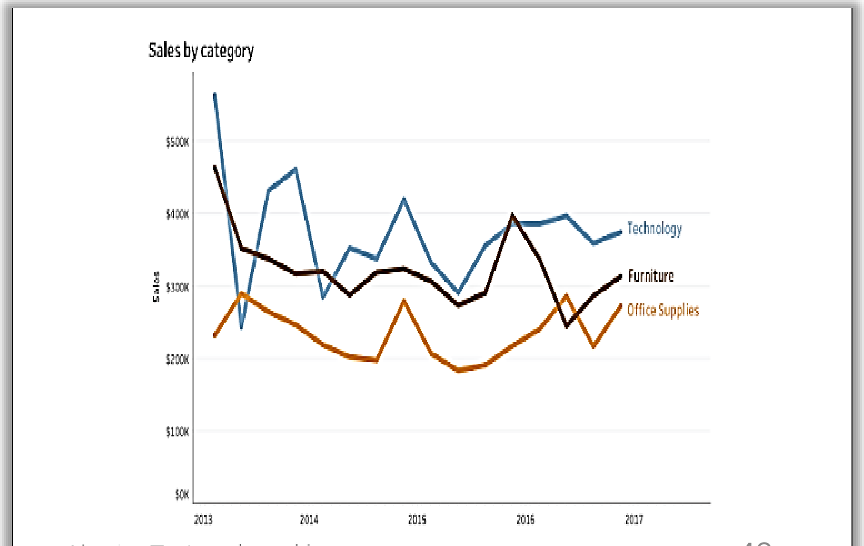


FIGURE 1.2 Now can you see the trends?

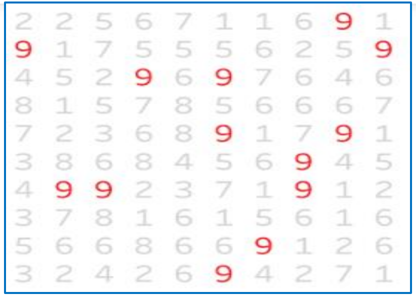
Pre-Attentive Attributes / Enduring Dispositions

Automatic influence (conscious decision) ,where people direct attention

2	2	5	6	7	1	1	6	9	1
9	1	7	5	5	5	6	2	5	9
4	5	2	9	6	9	7	6	4	6
8	1	5	7	8	5	6	6	6	7
7	2	3	6	8	9	1	7	9	1
3	8	6	8	4	5	6	9	4	5
4	9	9	2	3	7	1	9	1	2
3	7	8	1	6	1	5	6	1	6
5	6	6	8	6	6	9	1	2	6
3	2	4	2	6	9	4	2	7	1

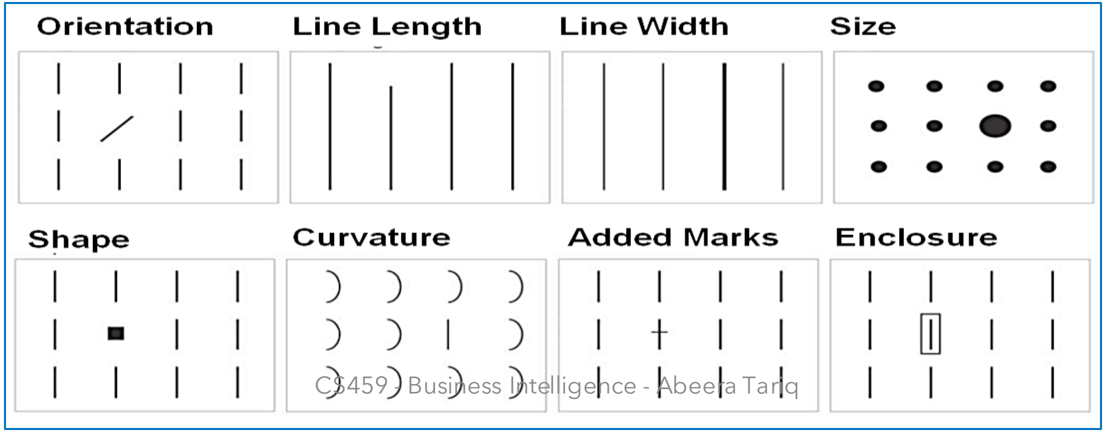
vs

Color



2	2	5	6	7	1	1	6	9	1
9	1	7	5	5	5	6	2	5	9
4	5	2	9	6	9	7	6	4	6
8	1	5	7	8	5	6	6	6	7
7	2	3	6	8	9	1	7	9	1
3	8	6	8	4	5	6	9	4	5
4	9	9	2	3	7	1	9	1	2
3	7	8	1	6	1	5	6	1	6
5	6	6	8	6	6	9	1	2	6
3	2	4	2	6	9	4	2	7	1

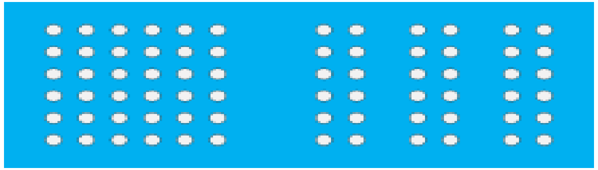
Form


Orientation
Line Length
Line Width
Size
Shape
Curvature
Added Marks
Enclosure

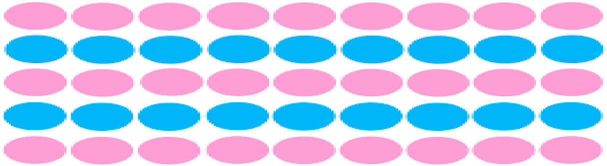
Gestalt Theory & Design Principals

- **Theory**
  - The mind is constantly trying to make sense of the world; when the human mind (perceptual system) forms a percept or "gestalt", the whole has a reality of its own, independent of the parts.

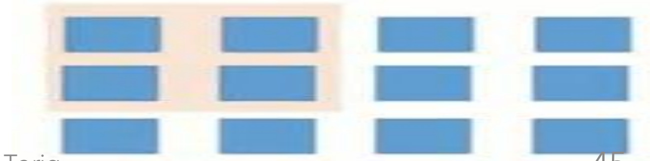
- **Principals (8):**
  - Proximity (objects close to each other are perceived as a group)



  - Similarity (elements tend to be integrated into groups if they are similar to each other)



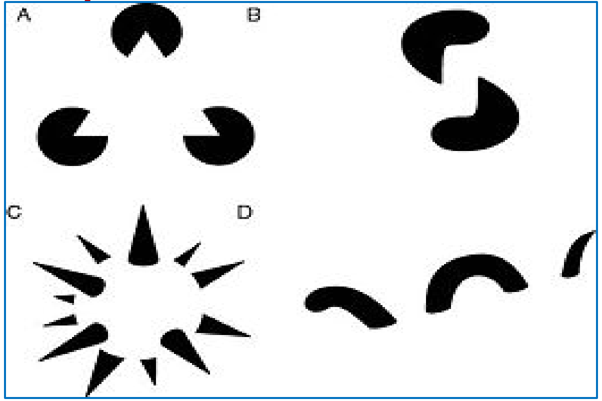
  - Enclosure (objects with a boundary surrounding them are perceived to belong together)



Gestalt Examples

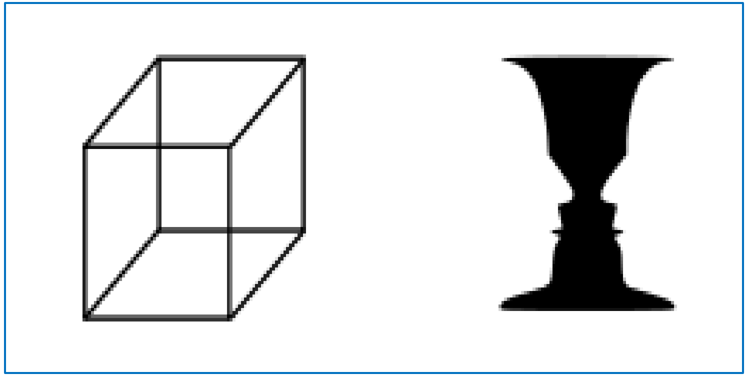
Reification (abstract to real)

- Illusory contours
- Constructive or generative aspect of perception, by which the experienced percept contains more explicit spatial information than the sensory stimulus on which it is based.
- ***The whole is other than the sum of the parts***



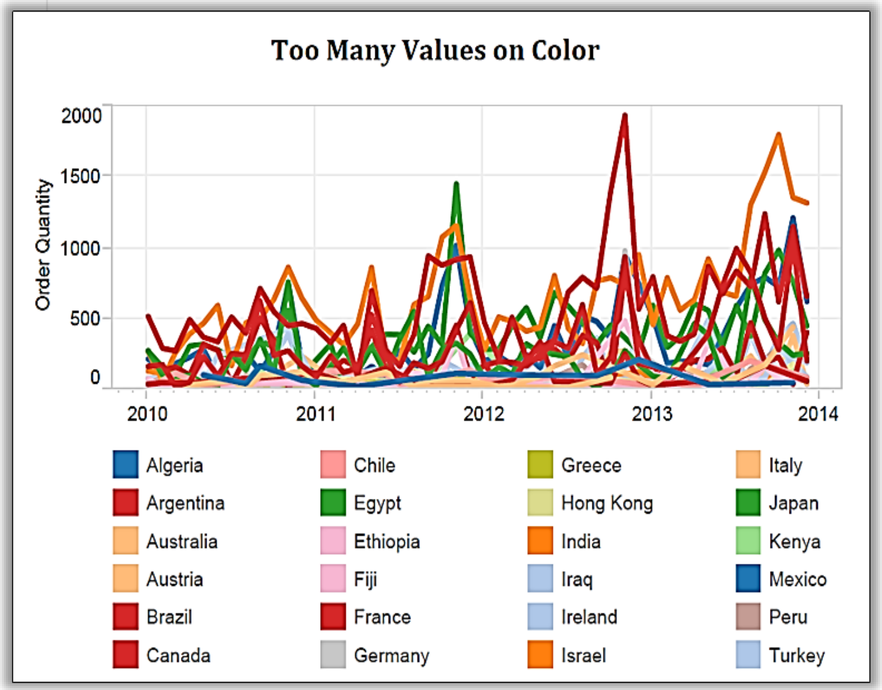
Multistability (Multistable Perception) / Figure-Ground Articulation

- Tendency of ambiguous perceptual experiences to pop back and forth unstably between two or more alternative interpretations.
- E.g. Necker cube and
  Rubin's Figure/Vase illusion

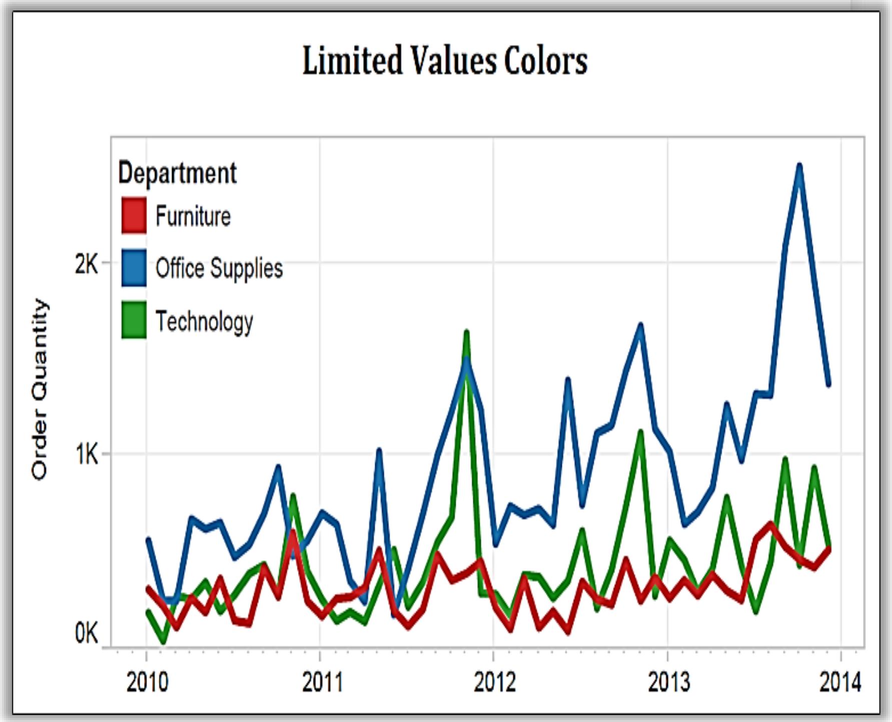


Color Choice

Limit to 7 or less colors

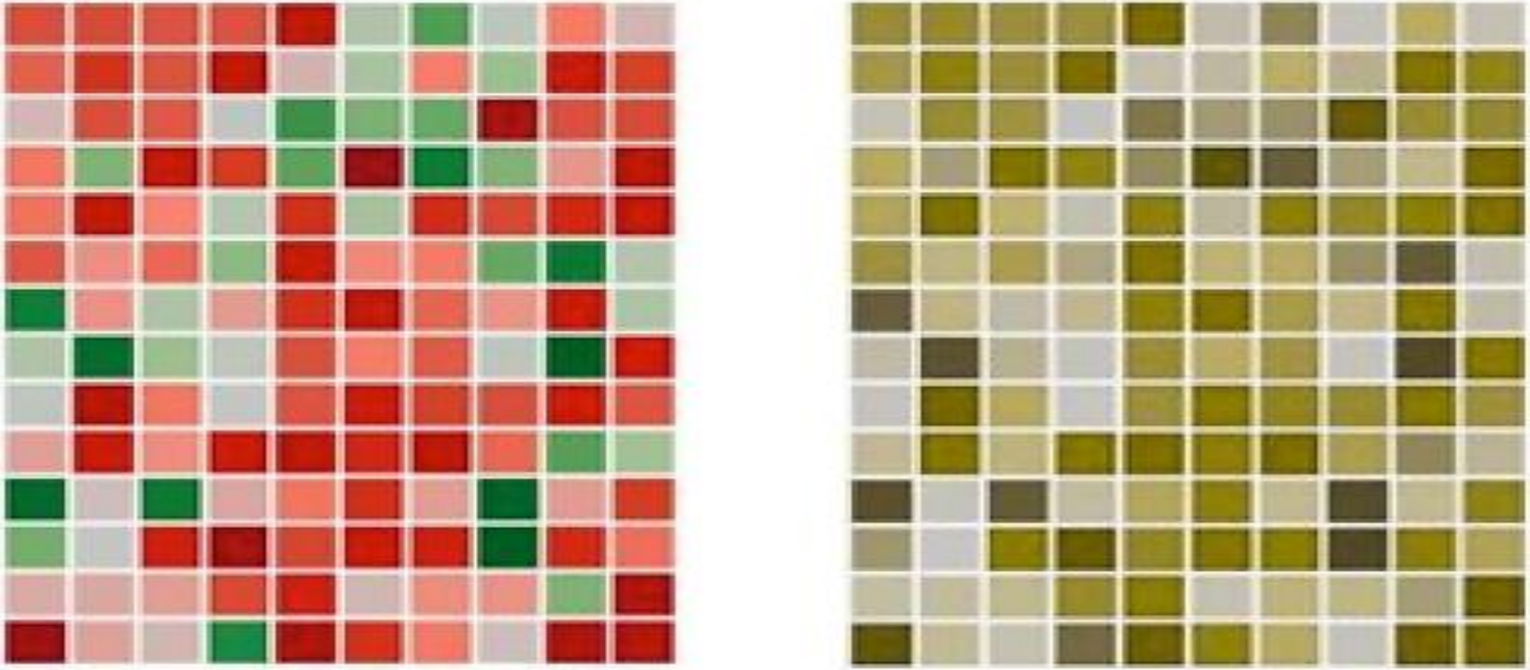


vs



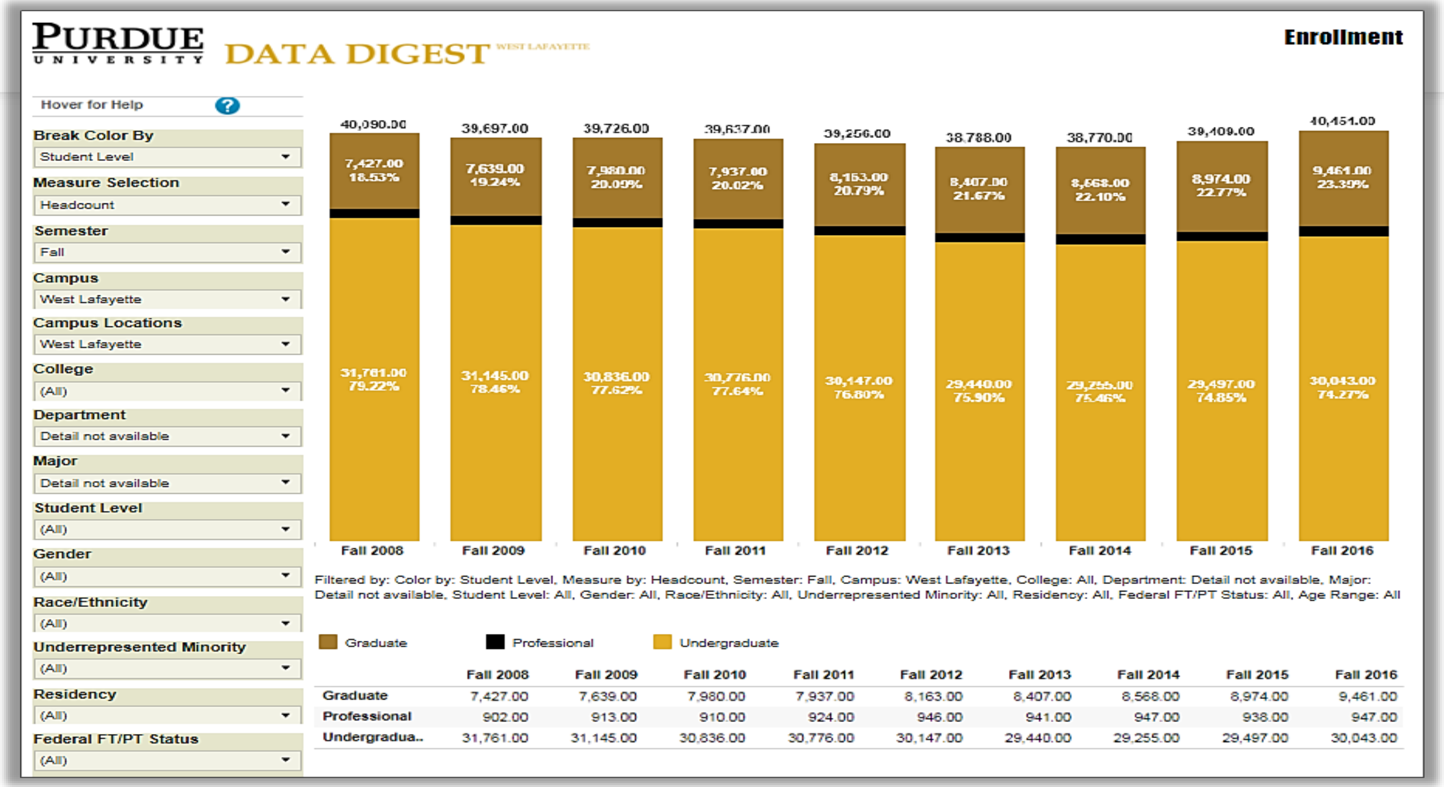
Design for Accessibility

Color Vision Deficiency (color blindness) affects ~10% population



Stay On-Brand / On-Theme

Utilize online color palette generators


PURDUE UNIVERSITY
DATA DIGEST WEST LAFAYETTE
Enrollment
Hover for Help
?
40,090.00
7,427.00 18.53%
31,761.00 79.22%
39,697.00
7,639.00 19.24%
31,145.00 78.46%
39,726.00
7,980.00 20.09%
30,836.00 77.62%
39,637.00
7,937.00 20.02%
30,776.00 77.64%
39,256.00
8,163.00 20.79%
30,147.00 76.80%
38,788.00
8,407.00 21.67%
29,440.00 75.90%
38,770.00
8,568.00 22.10%
29,255.00 75.46%
39,409.00
8,974.00 22.77%
29,497.00 74.85%
40,451.00
9,461.00 23.39%
30,043.00 74.27%
Fall 2008
Fall 2009
Fall 2010
Fall 2011
Fall 2012
Fall 2013
Fall 2014
Fall 2015
Fall 2016
Graduate
Professional
Undergraduate

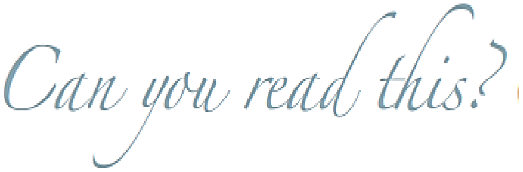
Break Color By: Student Level
Measure Selection: Headcount
Semester: Fall
Campus: West Lafayette
Campus Locations: West Lafayette
College: (All)
Department: Detail not available
Major: Detail not available
Student Level: (All)
Gender: (All)
Race/Ethnicity: (All)
Underrepresented Minority: (All)
Residency: (All)
Federal FT/PT Status: (All)

Filtered by: Color by: Student Level, Measure by: Headcount, Semester: Fall, Campus: West Lafayette, College: All, Department: Detail not available, Major: Detail not available, Student Level: All, Gender: All, Race/Ethnicity: All, Underrepresented Minority: All, Residency: All, Federal FT/PT Status: All, Age Range: All

	Fall 2008	Fall 2009	Fall 2010	Fall 2011	Fall 2012	Fall 2013	Fall 2014	Fall 2015	Fall 2016
Graduate	7,427.00	7,639.00	7,980.00	7,937.00	8,163.00	8,407.00	8,568.00	8,974.00	9,461.00
Professional	902.00	913.00	910.00	924.00	946.00	941.00	947.00	938.00	947.00
Undergradua..	31,761.00	31,145.00	30,836.00	30,776.00	30,147.00	29,440.00	29,255.00	29,497.00	30,043.00

Font Choice

Avoid scripts:



Can you read this?

Recommended fonts

Overall Dashboard

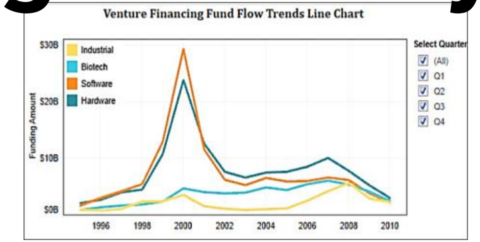
- Trebuchet MS or Verdana (especially for tables and numbers)
- Arial
- Georgia
- Tahoma
- Times New Roman
- Lucida sans

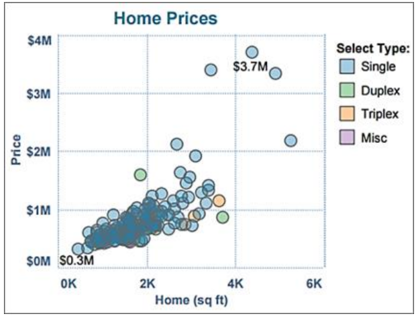
Tooltips

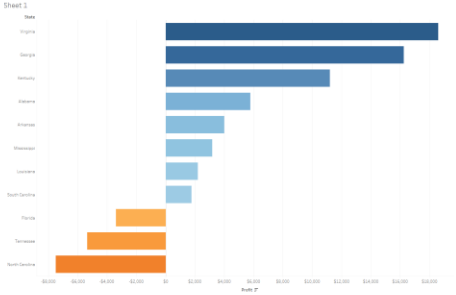
- Calibri
- Cambria

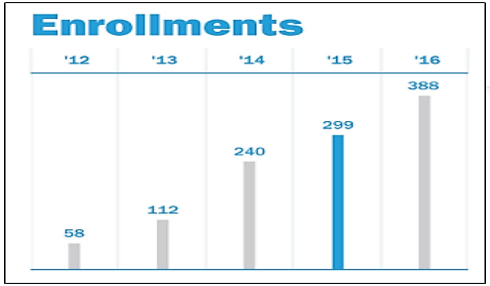
Choose the Right Chart Type

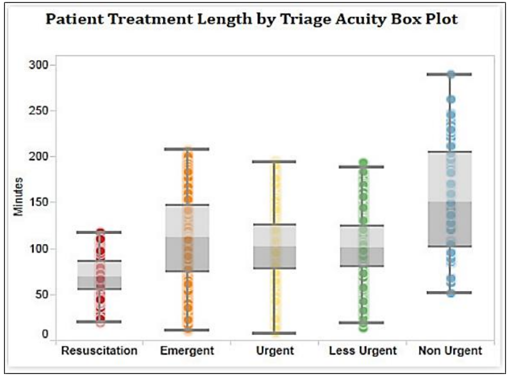
- Trends over Time:
  - line chart
- Comparison & Ranking:
  - bar chart
- Correlation:
  - scatterplot
- Distribution:
  - box plot





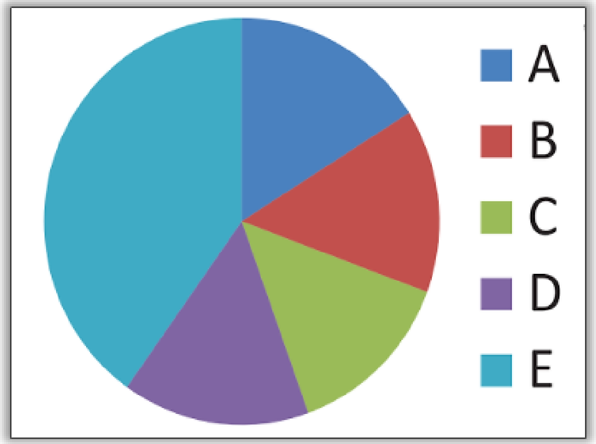




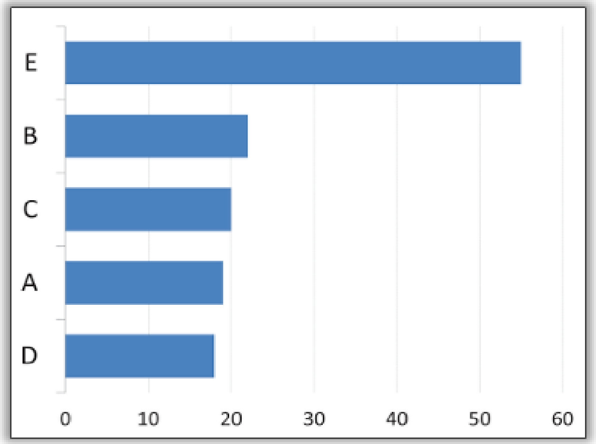


Avoid Pie Charts

Much harder for humans to differentiate differences in circles or angles than lines



vs

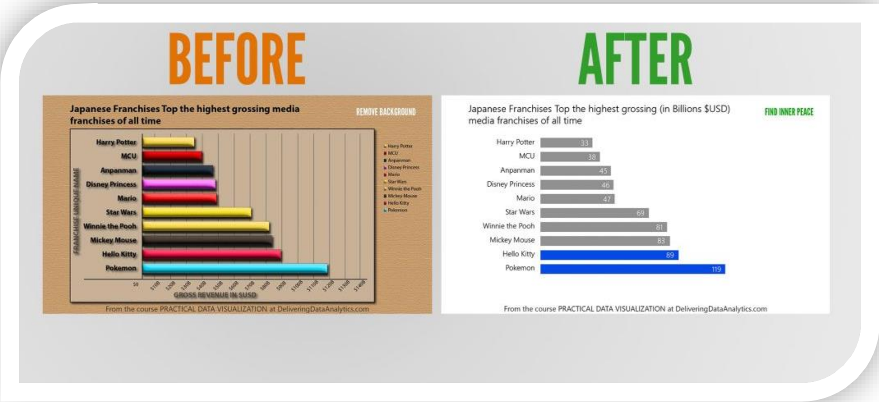


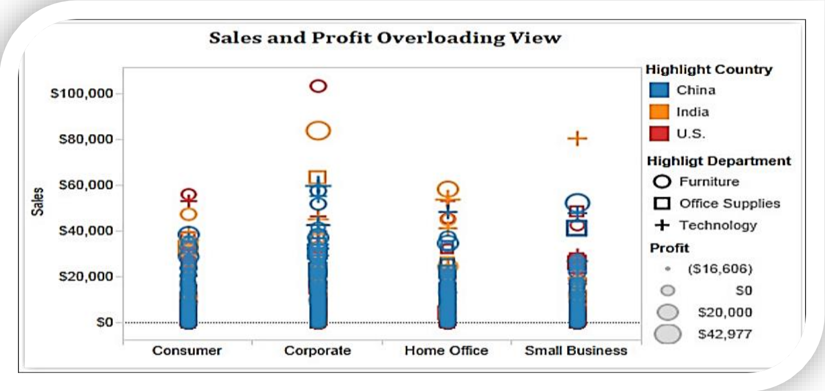
5. Build in functionality

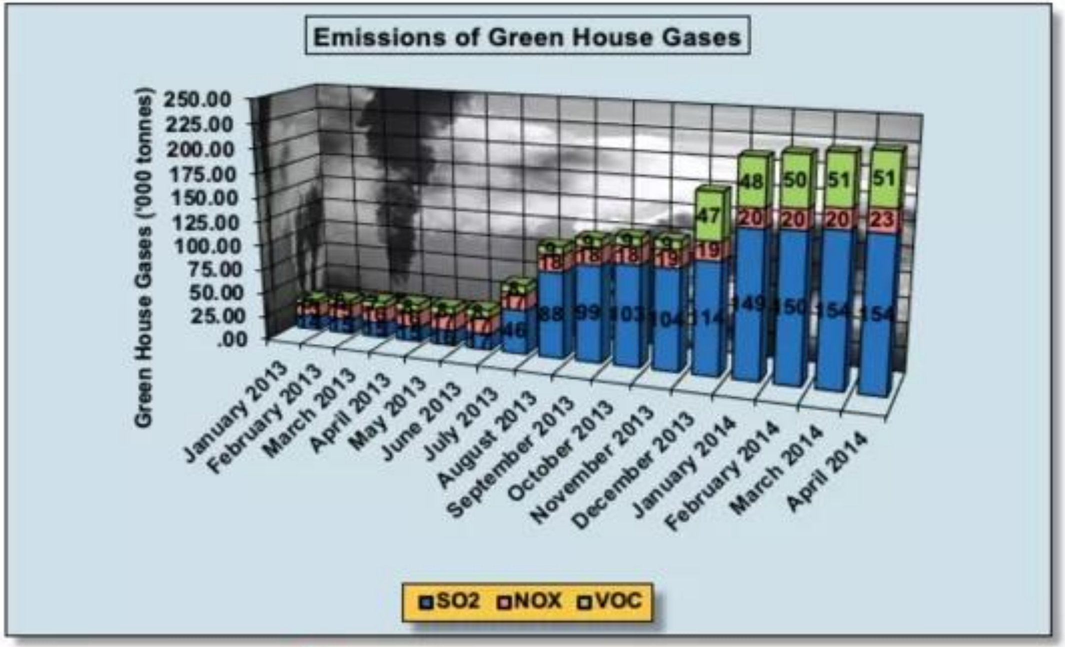
- Add interactivity to encourage exploration
- Drill-downs
    - Allow users to go from a summary metric/view to deeper detail that provides more context and/or breakout of the information.
- Show filters and parameters
- Enable highlighting
- Action filters
- Tooltips

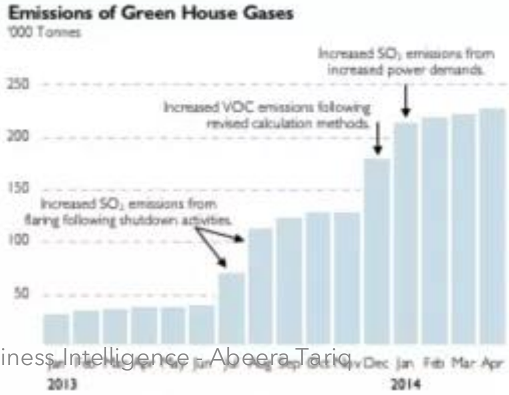
6. Avoid chart junk

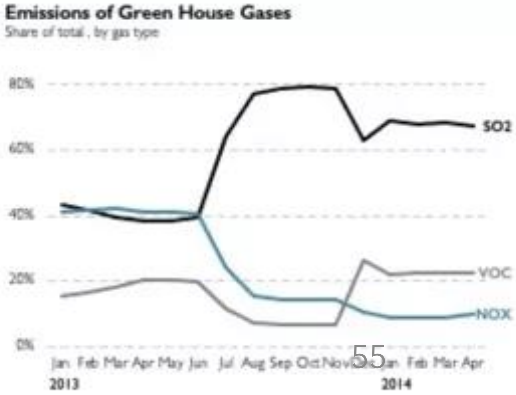
- Avoid chart overload
- Unless it serves a purpose, don't include it, e.g. 3D effects, image overload, chart shading, label overload
- Prioritize data-ink ratio (how much ink used to present as compared to total ink (pixels) used in entire display)
- Resist temptation to use purely decorative chart types

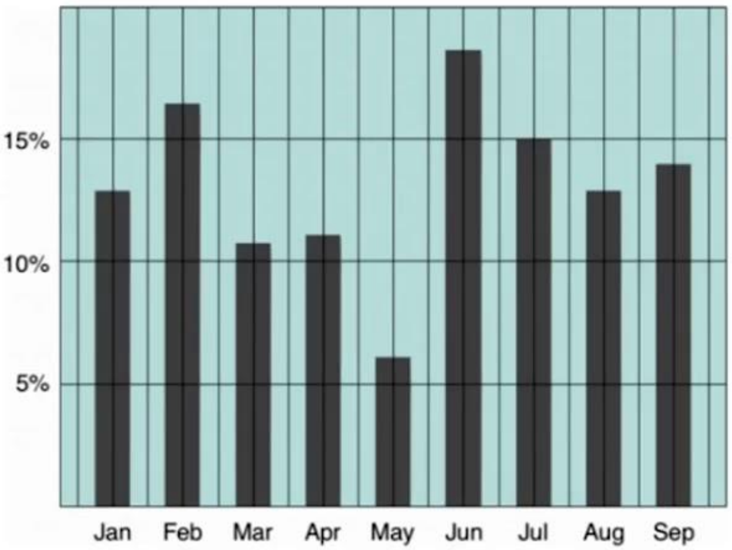




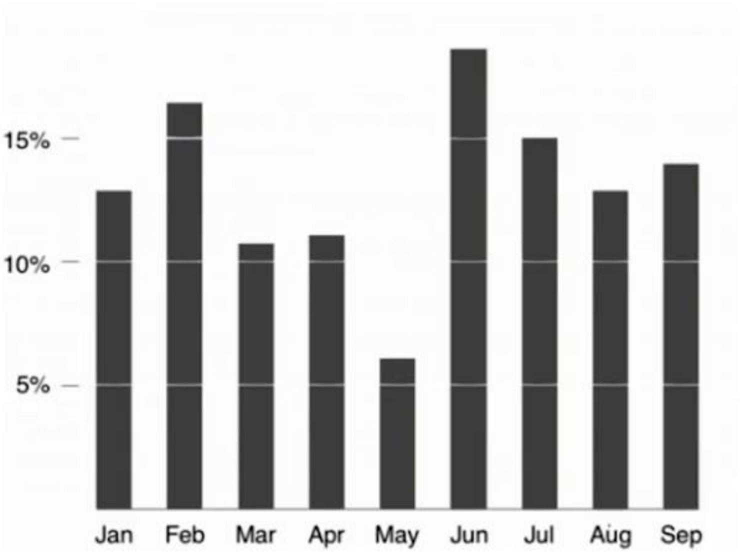

Emissions of Green House Gases
Green House Gases ('000 tonnes)
250.00
225.00
200.00
175.00
150.00
125.00
100.00
75.00
50.00
25.00
.00
January 2013
February 2013
March 2013
April 2013
May 2013
June 2013
July 2013
August 2013
September 2013
October 2013
November 2013
December 2013
January 2014
February 2014
March 2014
April 2014
46
17
8
88
18
9
99
18
9
103
18
9
104
19
9
114
19
47
149
20
48
150
20
50
154
20
51
154
23
51
■SO2 ■NOX ■VOC


Emissions of Green House Gases
'000 Tonnes
250
200
150
100
50
Increased SO₂ emissions from increased power demands.
Increased VOC emissions following revised calculation methods.
Increased SO₂ emissions from flaring following shutdown activities.
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
2013
2014


Emissions of Green House Gases
Share of total , by gas type
80%
60%
40%
20%
0%
SO2
VOC
NOX
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
2013
2014

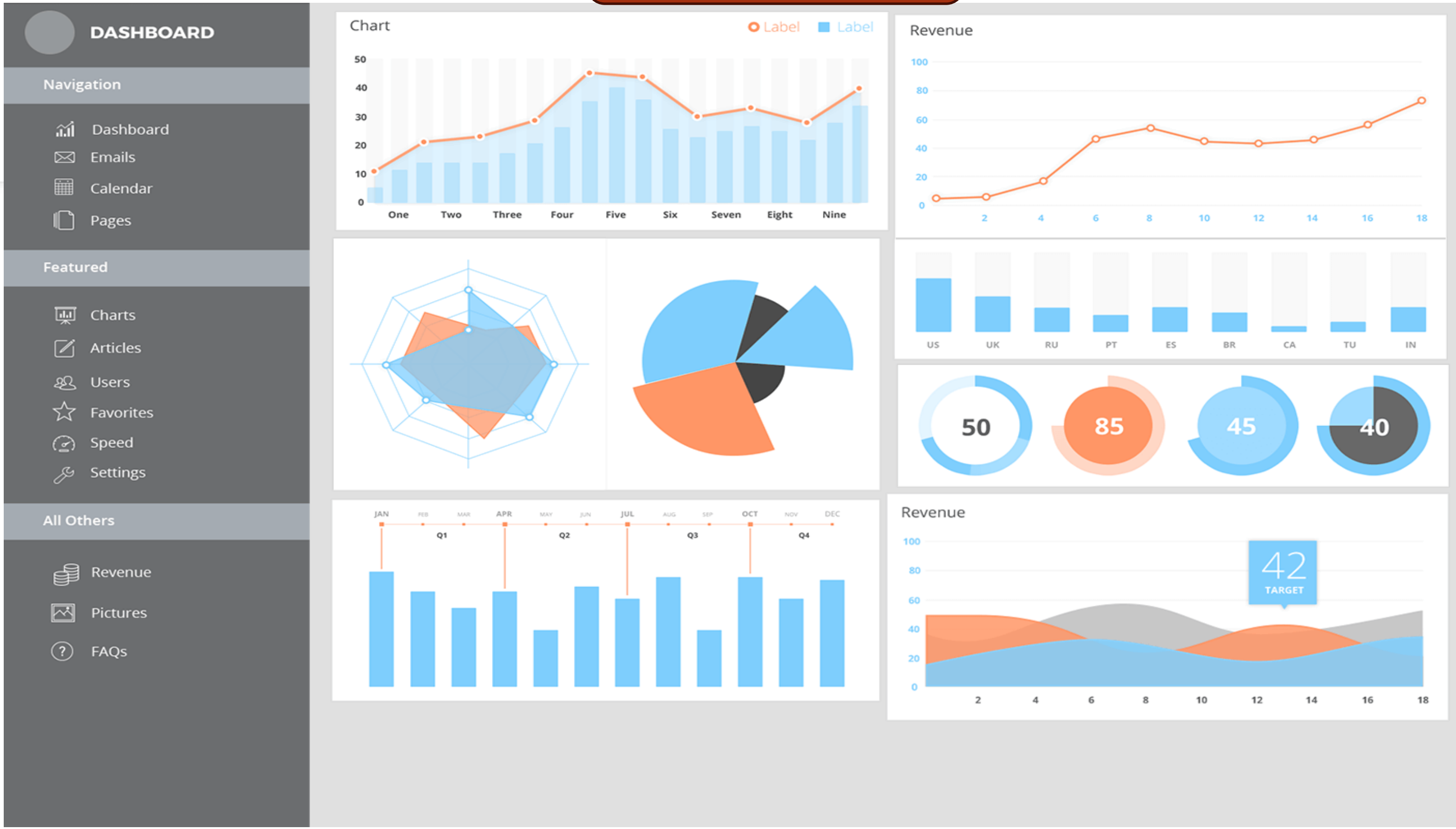


low data-ink ratio

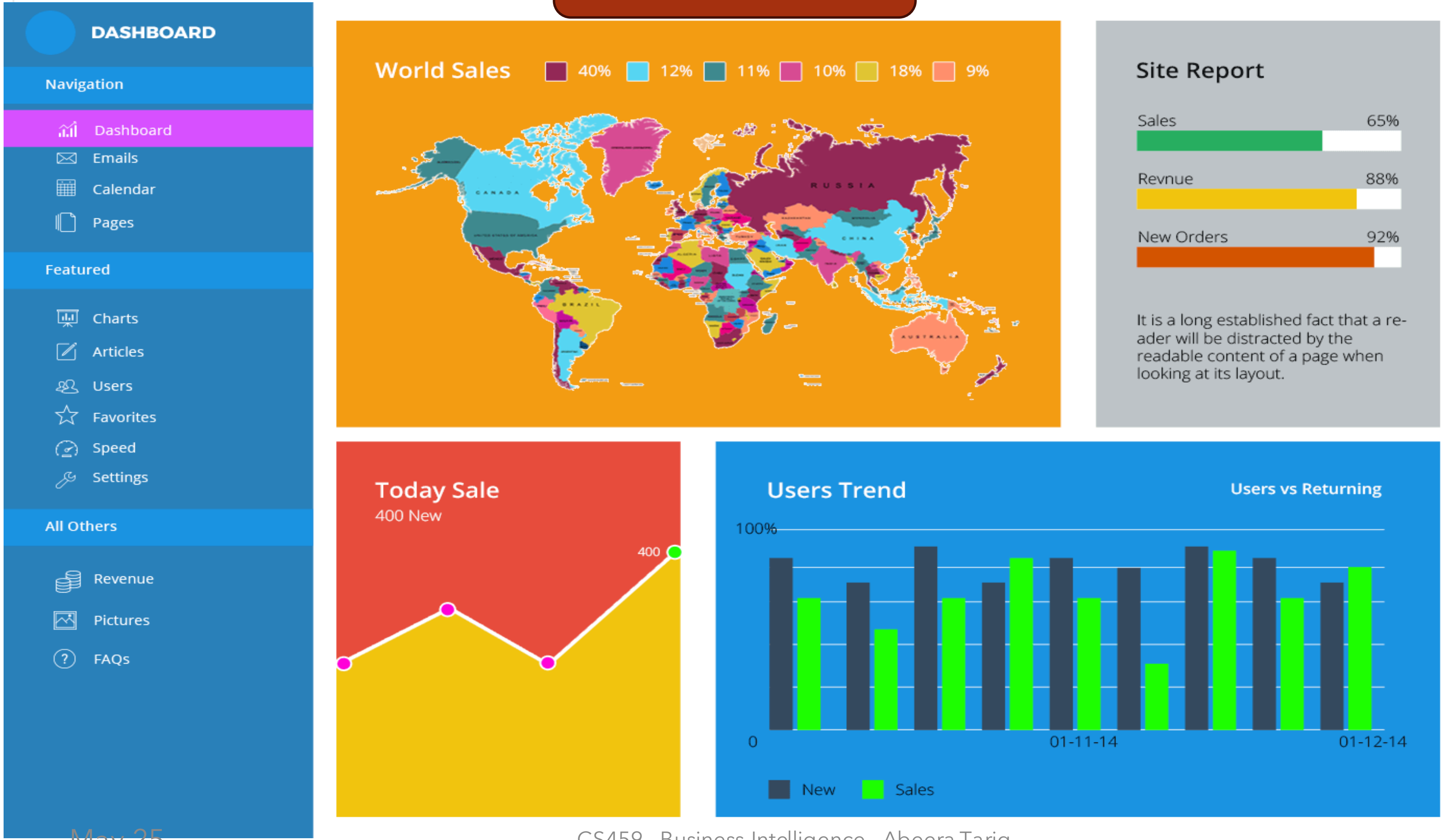


high data-ink ratio

Too much clutter

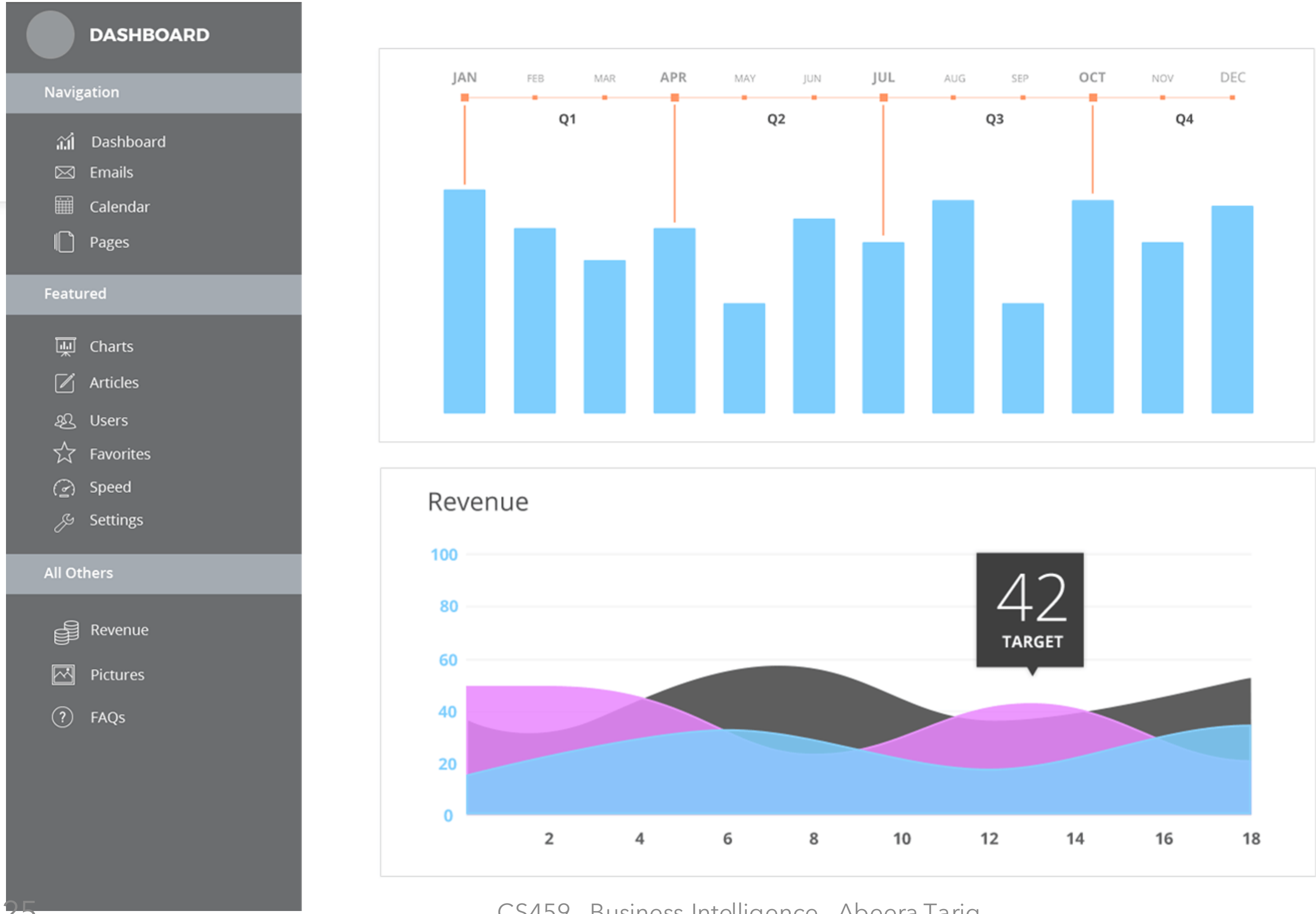

DASHBOARD
Navigation
Dashboard
Emails
Calendar
Pages
Featured
Charts
Articles
Users
Favorites
Speed
Settings
All Others
Revenue
Pictures
FAQs
Chart
Label
Label
50
40
30
20
10
0
One
Two
Three
Four
Five
Six
Seven
Eight
Nine
Revenue
100
80
60
40
20
0
2
4
6
8
10
12
14
16
18
US
UK
RU
PT
ES
BR
CA
TU
IN
50
85
45
40
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Q1
Q2
Q3
Q4
Revenue
100
80
60
40
20
0
2
4
6
8
10
12
14
16
18
42
TARGET

Too many colors

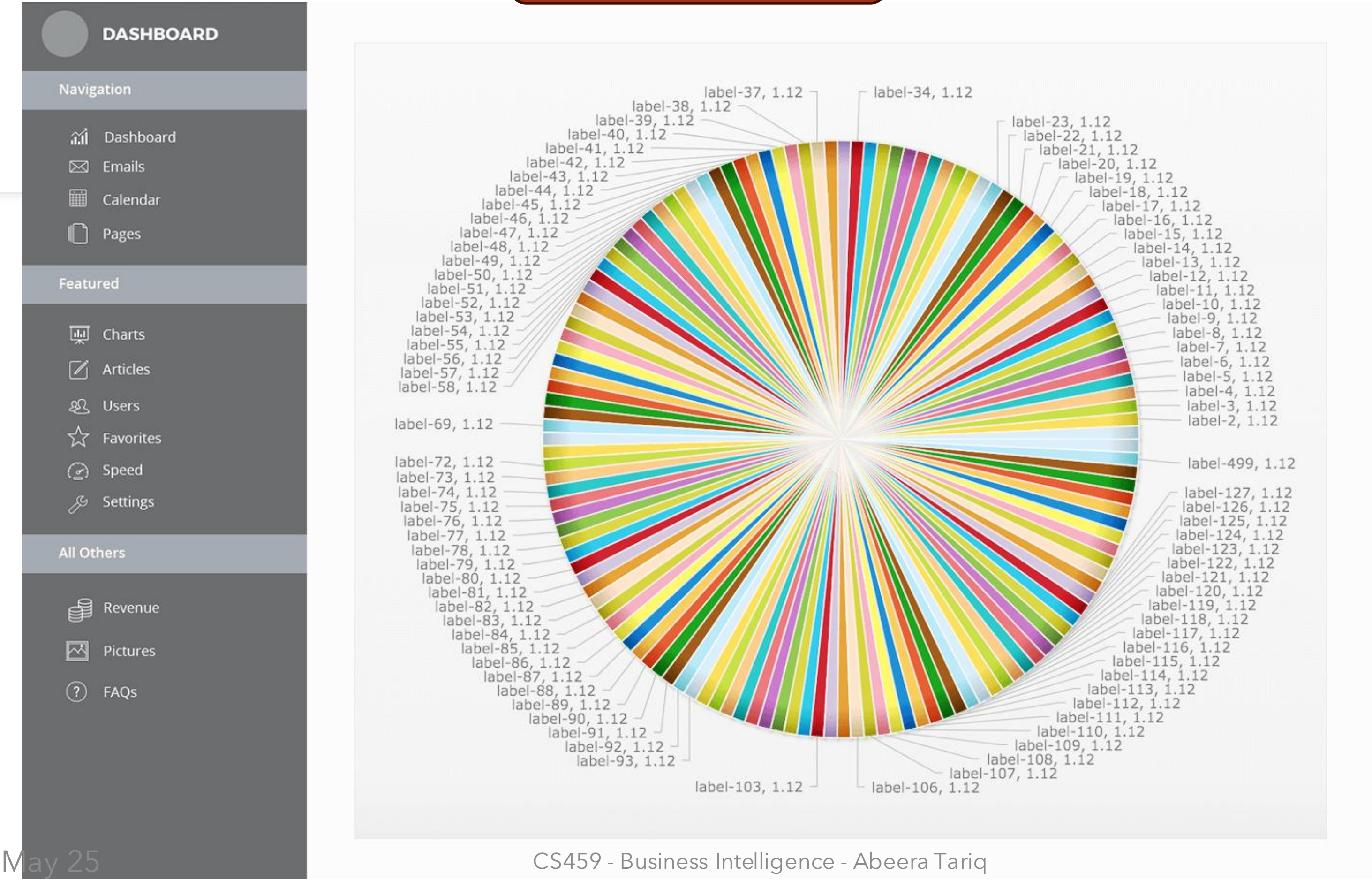

DASHBOARD
Navigation
Dashboard
Emails
Calendar
Pages
Featured
Charts
Articles
Users
Favorites
Speed
Settings
All Others
Revenue
Pictures
FAQs
World Sales
40%
12%
11%
10%
18%
9%
CANADA
RUSSIA
CHINA
BRAZIL
AUSTRALIA
Site Report
Sales
65%
Revnue
88%
New Orders
92%
Today Sale
400 New
400
Users Trend
Users vs Returning
100%
0
01-11-14
01-12-14
New
Sales

It is a long established fact that a reader will be distracted by the readable content of a page when looking at its layout.

Lack of context


DASHBOARD
Navigation
Dashboard
Emails
Calendar
Pages
Featured
Charts
Articles
Users
Favorites
Speed
Settings
All Others
Revenue
Pictures
FAQs
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Q1
Q2
Q3
Q4
Revenue
100
80
60
40
20
0
2
4
6
8
10
12
14
16
18
42
TARGET

Bad Data-to-Vis Pairing


DASHBOARD
Navigation
Dashboard
Emails
Calendar
Pages
Featured
Charts
Articles
Users
Favorites
Speed
Settings
All Others
Revenue
Pictures
FAQs
label-37, 1.12
label-38, 1.12
label-39, 1.12
label-40, 1.12
label-41, 1.12
label-42, 1.12
label-43, 1.12
label-44, 1.12
label-45, 1.12
label-46, 1.12
label-47, 1.12
label-48, 1.12
label-49, 1.12
label-50, 1.12
label-51, 1.12
label-52, 1.12
label-53, 1.12
label-54, 1.12
label-55, 1.12
label-56, 1.12
label-57, 1.12
label-58, 1.12
label-69, 1.12
label-72, 1.12
label-73, 1.12
label-74, 1.12
label-75, 1.12
label-76, 1.12
label-77, 1.12
label-78, 1.12
label-79, 1.12
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label-83, 1.12
label-84, 1.12
label-85, 1.12
label-86, 1.12
label-87, 1.12
label-88, 1.12
label-89, 1.12
label-90, 1.12
label-91, 1.12
label-92, 1.12
label-93, 1.12
label-103, 1.12
label-106, 1.12
label-34, 1.12
label-23, 1.12
label-22, 1.12
label-21, 1.12
label-20, 1.12
label-19, 1.12
label-18, 1.12
label-17, 1.12
label-16, 1.12
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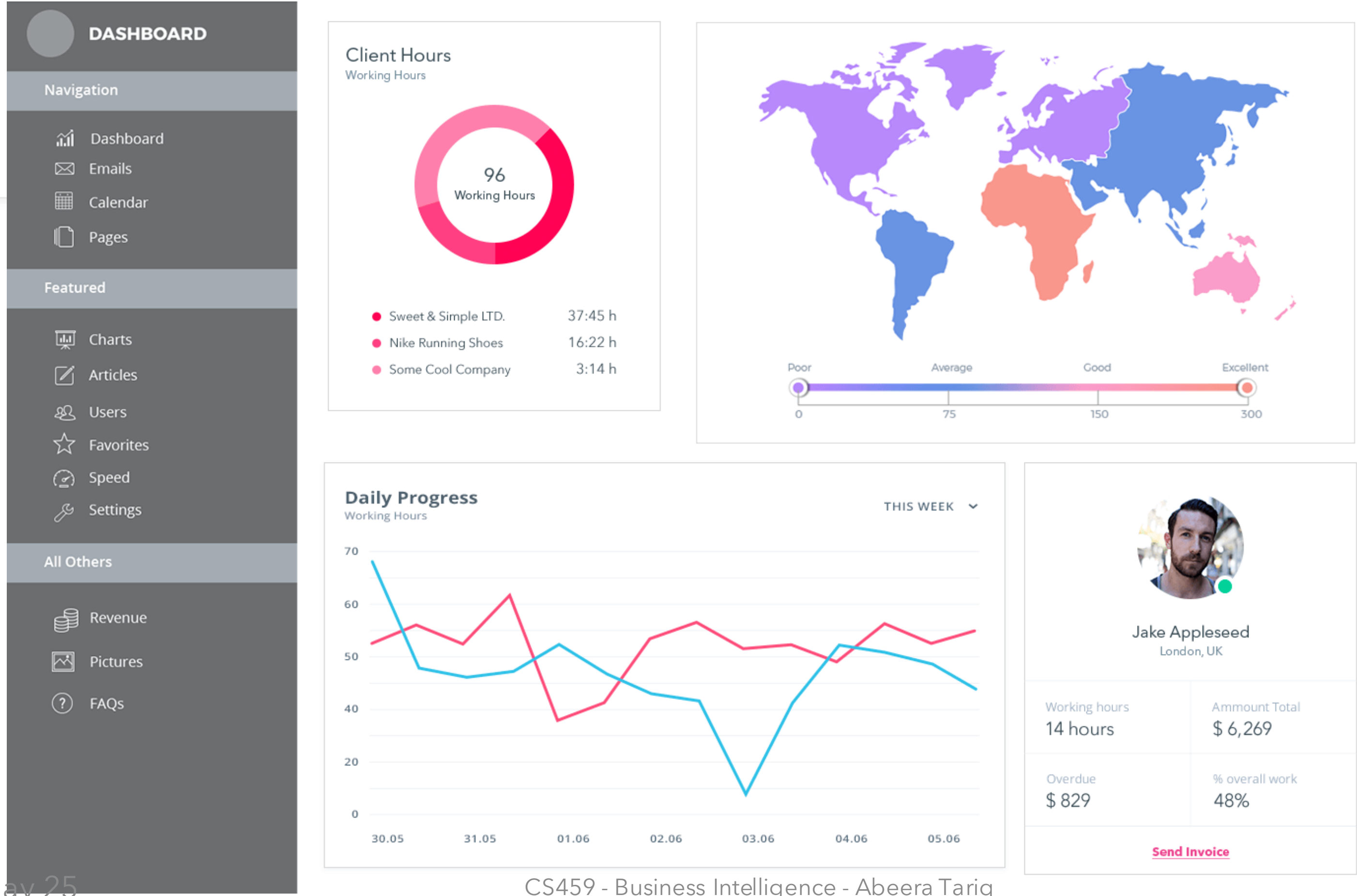
label-499, 1.12
label-127, 1.12
label-126, 1.12
label-125, 1.12
label-124, 1.12
label-123, 1.12
label-122, 1.12
label-121, 1.12
label-120, 1.12
label-119, 1.12
label-118, 1.12
label-117, 1.12
label-116, 1.12
label-115, 1.12
label-114, 1.12
label-113, 1.12
label-112, 1.12
label-111, 1.12
label-110, 1.12
label-109, 1.12
label-108, 1.12
label-107, 1.12

Careless Arrangement

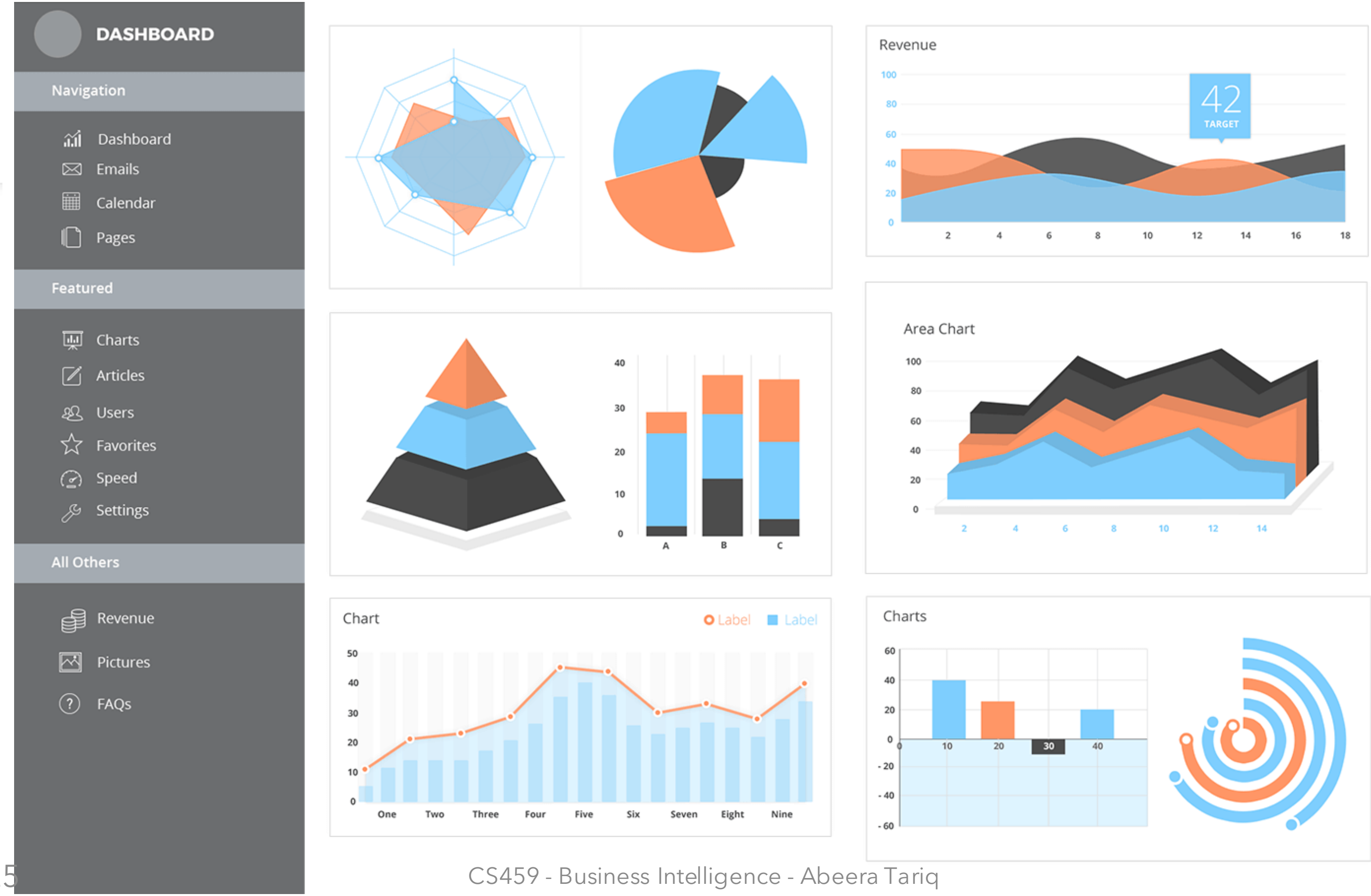

DASHBOARD
Navigation
Dashboard
Emails
Calendar
Pages
Featured
Charts
Articles
Users
Favorites
Speed
Settings
All Others
Revenue
Pictures
FAQs
Client Hours
Working Hours
96
Working Hours
Poor
Average
Good
Excellent
0
75
150
300
Daily Progress
Working Hours
THIS WEEK
70
60
50
40
20
0
30.05
31.05
01.06
02.06
03.06
04.06
05.06
Send Invoice

● Sweet & Simple LTD.	37:45 h
● Nike Running Shoes	16:22 h
● Some Cool Company	3:14 h

Jake Appleseed
London, UK

Working hours 14 hours	Ammount Total $ 6,269
Overdue $ 829	% overall work 48%

Unnecessary Variety


DASHBOARD
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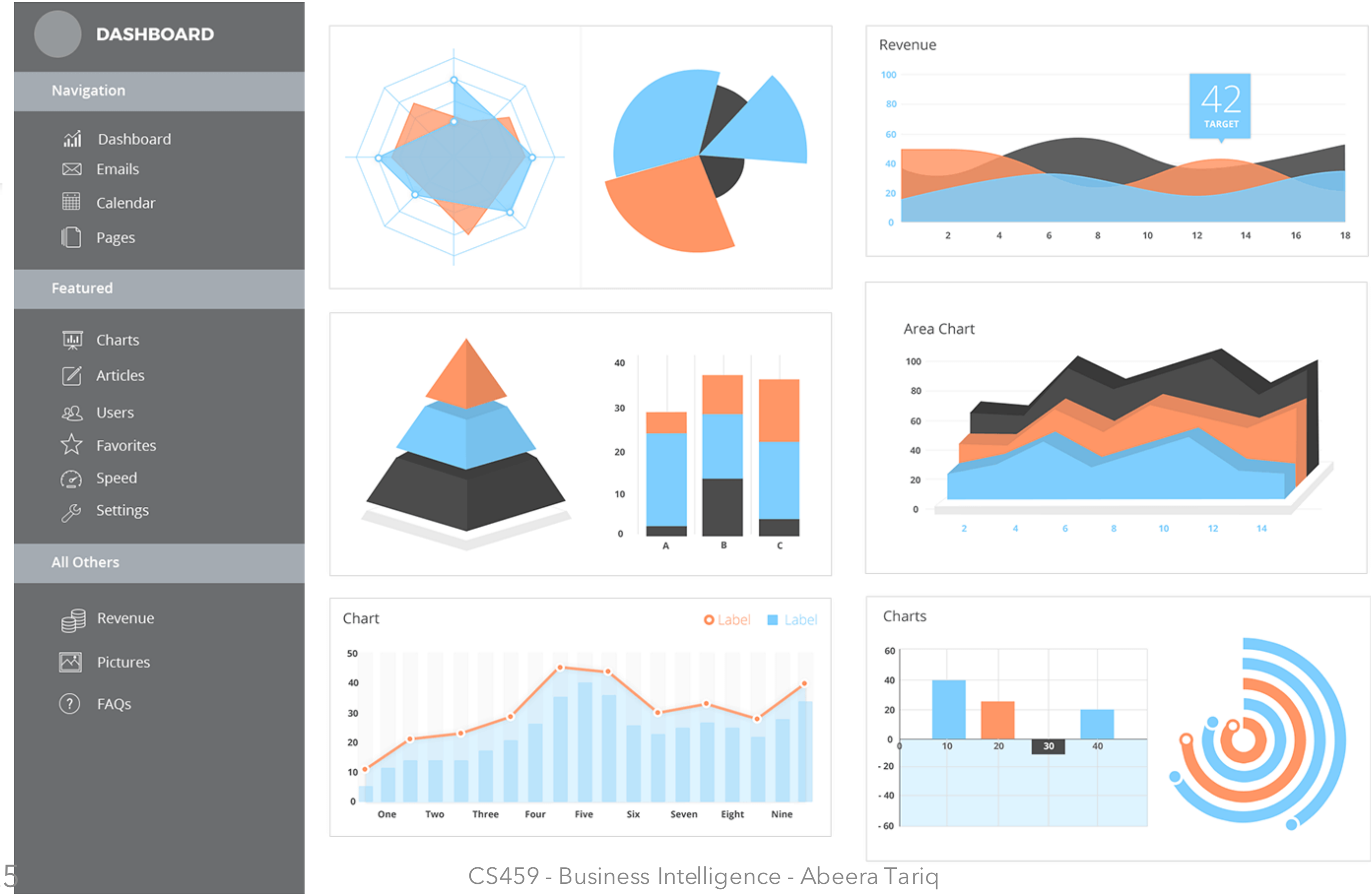
Dashboard
Emails
Calendar
Pages
Featured
Charts
Articles
Users
Favorites
Speed
Settings
All Others
Revenue
Pictures
FAQs
Revenue
42
TARGET
Area Chart
Chart
Label
Label
One
Two
Three
Four
Five
Six
Seven
Eight
Nine
A
B
C
Charts

Confusing Resemblance


DASHBOARD
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Articles
Users
Favorites
Speed
Settings
All Others
Revenue
Pictures
FAQs
Revenue
100
80
60
40
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2
4
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8
10
12
14
16
18
42
TARGET
40
30
20
10
0
A
B
C
Area Chart
100
80
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40
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12
14
Chart
Label
Label
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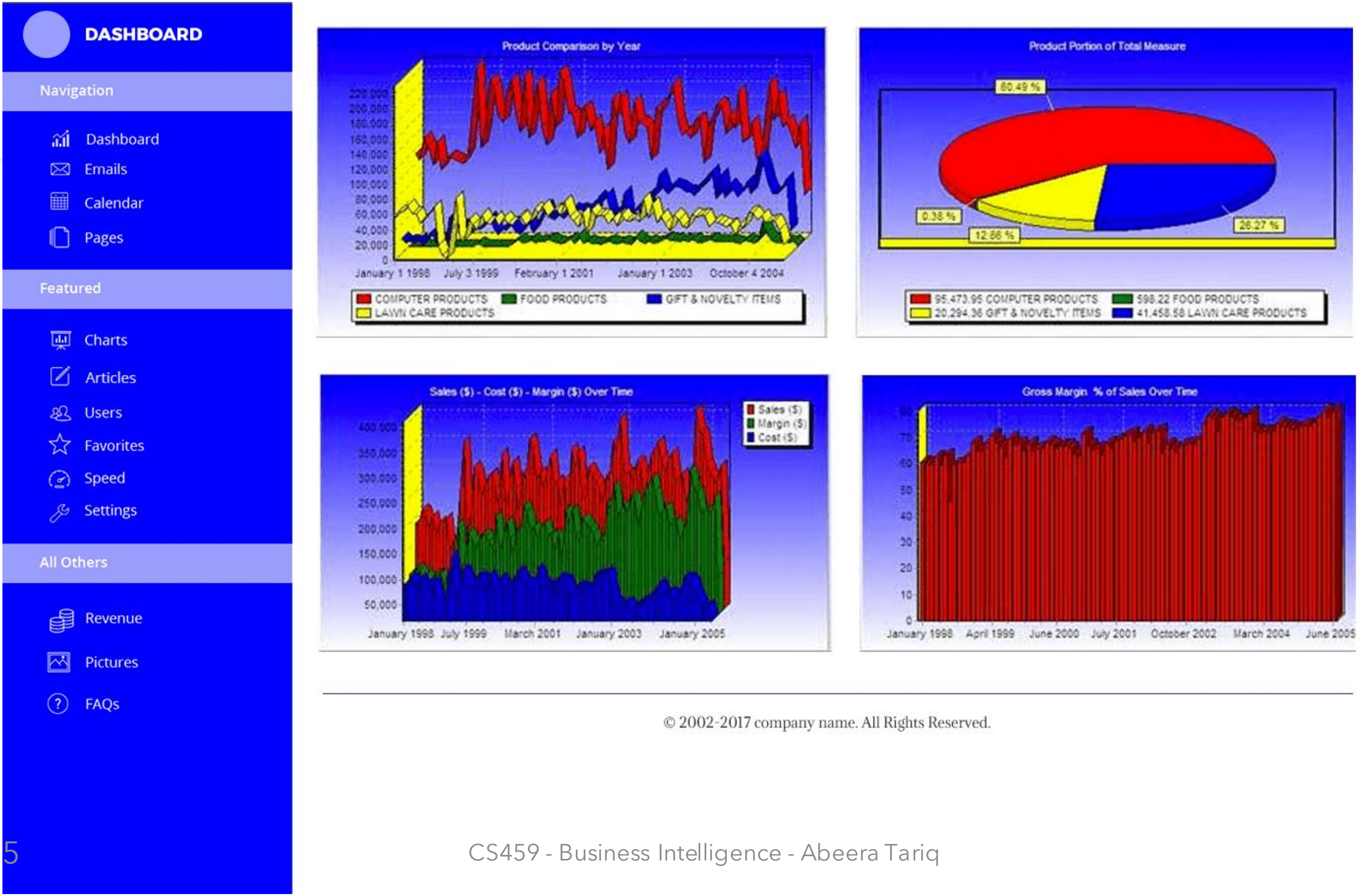
40
30
20
10
0
One
Two
Three
Four
Five
Six
Seven
Eight
Nine
Charts
60
40
20
0
- 20
- 40
- 60
10
20
30
40

Ugly


DASHBOARD
Navigation
Dashboard
Emails
Calendar
Pages
Featured
Charts
Articles
Users
Favorites
Speed
Settings
All Others
Revenue
Pictures
FAQs
Product Comparison by Year
220,000
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
January 1 1998
July 3 1999
February 1 2001
January 1 2003
October 4 2004
COMPUTER PRODUCTS
FOOD PRODUCTS
GIFT & NOVELTY ITEMS
LAWN CARE PRODUCTS
Product Portion of Total Measure
60.49 %
0.38 %
12.86 %
26.27 %
95,473.95 COMPUTER PRODUCTS
598.22 FOOD PRODUCTS
20,294.36 GIFT & NOVELTY ITEMS
41,458.58 LAWN CARE PRODUCTS
Sales ($) - Cost ($) - Margin ($) Over Time
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
January 1998
July 1999
March 2001
January 2003
January 2005
Sales ($)
Margin ($)
Cost ($)
Gross Margin % of Sales Over Time
80
70
60
50
40
30
20
10
0
January 1998
April 1999
June 2000
July 2001
October 2002
March 2004
June 2005

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7. Follow the 4 C's of Visualization

1. **Clarity**
    - Defined audience, clear message, ease of understanding
2. **Concise**
    - Balance minimalism with detail, brevity with comprehensiveness
3. **Captivating**
    - Attracts and holds attention, is interesting
4. **Catalyst**
    - Prompts action

8. Tableau check list

1. What questions are you trying to answer?

- Does this visualization answer all of your questions?
- Is the purpose of the visualization clearly explained in its title or surrounding text?
- Can you understand the visualization in 30 seconds or less, without additional information?
- Does your visualization include a title? Is that title simple, informative, and eye-catching?
- Does your visualization include subtitles to guide your viewers?

8. Tableau check list

2. Do you have the right chart type for your analysis?

- What types of analysis are you performing?
- Have you selected the most suitable chart type(s) for your types of analysis?
- Have you considered alternative chart types that could work better than the ones you have chosen?

3. Are your views effective?

- Are your most important data shown on the X- and Y-axes and your less important data encoded in color or shape attributes?
- Are your views oriented intuitively—do they cater to the way your viewers read and perceive data?
- Have you limited the number of measures or dimensions in a single view so that your users can see your data?
- Have you limited your usage of colors and shapes so that your users can distinguish them and see patterns?

8. Tableau check list

4. Is your dashboard holistic?

- Do all your views fit together to tell a single story?
- Do all your views flow well from one to the next? Are they in a good order?
- Do your most important views appear in the top or top-left corner?
- Are secondary elements in your dashboard placed well so they support the views without interrupting them?
- Are your filters in the right locations?
- Do your filters work correctly? Do views become blank or downright confusing if you apply a filter?
- Do your filters apply to the right scope?
- Are your filter titles informative? Can viewers easily understand how to interactive with your filters?
- Are your legends close to the views they apply to?
- Is your legend highlight button set to “on” or “off” according to your preference?
- Do you have filter, highlight or URL actions? If so, do they work?
- Are your legends and filters grouped and placed intuitively?
- Do you have scrollbars in your views? If so, are they acceptable ones?
- Are your views scrunched?
- Do your views fit consistently well when you apply filters?

8. Tableau check list

5. **Did you perfect your work?**
   - Do all the colors on your dashboard go together without clashing?
   - Do you have less than 7-10 colors on your dashboards?
   - Do you use fonts consistently in all of your views and no more than three different fonts on one dashboard?
   - Are your labels clear and concise? Are they placed optimally to help guide your viewers? Make sure subtitles are formatted to be subordinate to the main title.
   - Are your tooltips informative? Do they have the right format so that they're easy for viewers to use?

Prepare for BI Design Activity on Wednesday!

Sit with your project team members, bring in some extra pens and markers with you, ensure to download your dataset