

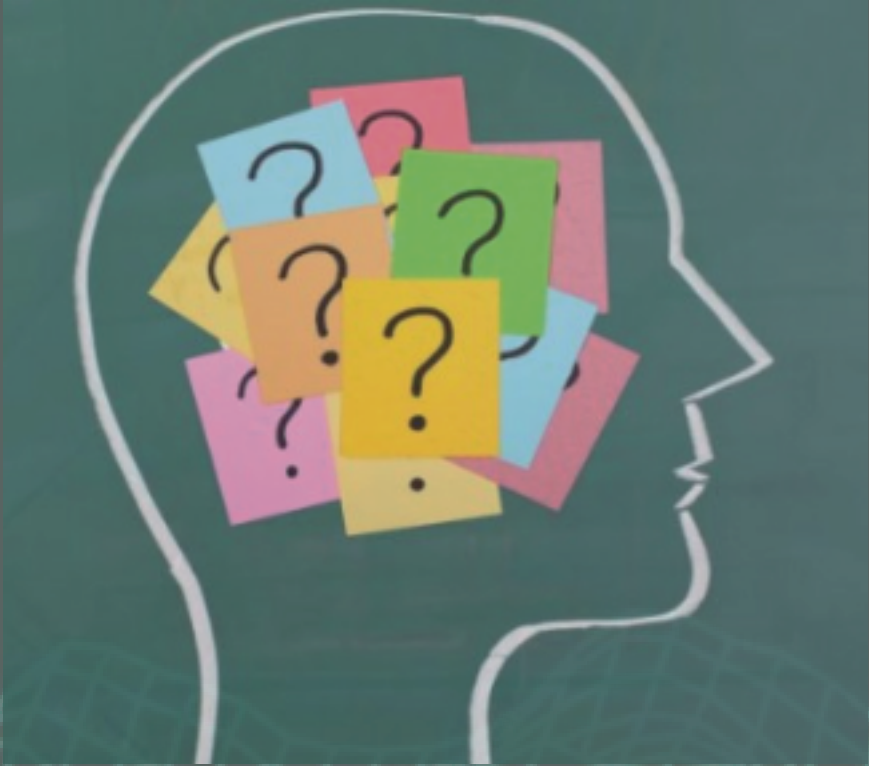
# RENDERING INDUSTRY DATA COMPREHENSIBLE BY UTILISING VISUALISATIONS

BY SHANE CLEMENT

## HUMAN PERCEPTION



## EMERGING COMPLEXITIES



| LIQUOR PRODUCT TILL VARIANCE REPORT - TOTS |              |        |        |        |          |          |          |          |          |  |
|--------------------------------------------|--------------|--------|--------|--------|----------|----------|----------|----------|----------|--|
| PRODUCT GROUP                              | QUANTITIES-> |        |        |        | VALUES-> |          |          |          |          |  |
|                                            | YIELD (%)    | STOCK  | ADJUST | NET    | TILL     | VARIANCE | STOCK    | TILL     | VARIANCE |  |
| SPIRITS                                    | 110.96%      | 572.0  | 2.0    | 570.0  | 646.0    | 76.0     | 1931.10  | 2142.70  | 211.60   |  |
| FORTIFIED WINES                            | 373.54%      | 6.0    | 0.0    | 6.0    | 27.0     | 21.0     | 18.90    | 70.60    | 51.70    |  |
| TABLE WINES                                | 88.64%       | 150.0  | 0.0    | 150.0  | 123.0    | -27.0    | 2201.90  | 1951.80  | -250.10  |  |
| DRAUGHT BEERS                              | 86.79%       | 216.0  | 4.0    | 212.0  | 184.0    | -28.0    | 636.00   | 552.00   | -84.00   |  |
| DRAUGHT LAGER                              | 87.54%       | 1004.0 | 38.0   | 966.0  | 847.0    | -119.0   | 3567.20  | 3122.70  | -444.50  |  |
| BOTTLED BEERS                              | 267.30%      | 52.0   | 0.0    | 52.0   | 140.0    | 88.0     | 168.80   | 451.20   | 282.40   |  |
| CIDERS                                     | 104.10%      | 320.0  | 3.0    | 317.0  | 330.0    | 13.0     | 1204.60  | 1254.00  | 49.40    |  |
| MINERALS                                   | 108.89%      | 2444.0 | 22.0   | 2422.0 | 2061.0   | -361.0   | 2371.60  | 2582.50  | 210.90   |  |
| SUNDRIES                                   | 76.92%       | 234.0  | 0.0    | 234.0  | 180.0    | -54.0    | 234.00   | 180.00   | -54.00   |  |
| TOTAL                                      | 99.78%       | 4998.0 | 69.0   | 4929.0 | 4538.0   | -391.0   | 12334.10 | 12307.50 | -26.60   |  |

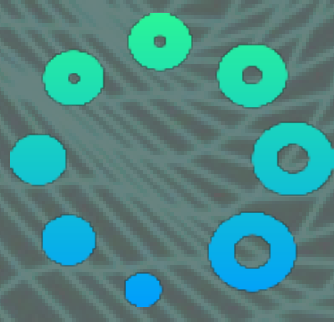
## ETL PROCESS



LOAD  
PREPARED  
DATA

TRANSFORM

EXTRACT  
RAW  
DATA



LOAD PDF

## DATA COMPREHENSION



### Abstract

The project developed a Data Visualisation (DV) application to facilitate and enhance user comprehension of inventory data. Through a comprehensive investigation, including a literature review, design, development, testing, and evaluation, the project addressed key objectives. Utilising principles of Human-Computer Interaction (HCI) and Gestalt Psychology, the application was designed to provide an intuitive user experience.

### Problem Statement

The project investigated a DV solution for a client who conducts inventory inspections. The client uses Capcon, an inventory management system that executes spreadsheets, which are saved in a Portable Document Format (PDF). Subsequently, interpretation challenges emerge when the client conveys the results to their customers. To combat this, an application was developed utilising an Extract, Transform, Load (ETL) process to manipulate and convert data into visualisations to enhance comprehension.

This project aimed to evaluate the effectiveness of the client adopting visualisations to analyse inventory data. A series of objectives was carried out that involve gathering system requirements through primary interviews and secondary research of literature, designing and developing the application by utilising various technologies and reflecting upon the effectiveness of the development model.

Utilising visualisations to comprehend data is an essential mechanism to assist organisations in making informed decisions. With data's proliferating nature, organisations can benefit from attaining knowledge of what their data represents for future business endeavours. Conveying data through traditional processes such as spreadsheets can be challenging to interpret and obtain a thorough understanding of the data's true potential, especially for non-technical personnel. Adopting visualisation techniques mitigated these challenges and facilitated users' decision-making.

### Literature

It is believed that DVs date back to the late 10th or early 11th century, with an example by Cicero consisting of the daily astronomy and physics being reviewed through time function collections of planetary orbits. Statistical graphics such as line graphs and bar and pie charts that are present today, were first created and published in 1786 by William Playfair.

The essence of DVs is imperative in modern organisations, aiding business processes through logical and graphical representations of intrinsic datasets. Bar charts compare data categories, pie charts differentiate size proportions, and line graphs detect trends.

Depending on user needs, interpreting how humans perceive visualisations is a cornerstone for the data to attain logical conveyance. There is an intact relationship between the human visual and thought processes.

How individuals process thought is largely attached to the human eye due to all bodily senses contributing to roughly 70% of vision. Cognitive and perception processes work simultaneously, and depending on the visualisation, patterns will either make sense or be imperceptible. Perception tasks include image processing, where part of the brain executes complex analysis to comprehend the visual input from the eye.

HCI involves the study of the interaction between humans and computers and comprises designing, implementing, and assessing interactive systems within the framework of user's tasks. The system's user interface is at the forefront of interaction. Designers and developers should maintain HCI principles that render computers usable to the user. Gestalt Psychology delves into the sensations and perceptions of humans. It suggests that the human brain initially divides elements into parts to create a perception of the world as a complete and meaningful experience. A series of Gestalt principles were formulated by the founders which contribute to grouping elements to coordinate visual perception. Proximity: results through objects being closely intact. Connection: the perception that two objects are joined together, and Figure and Ground: an object in the foreground is the Figure and anything that is located behind it is the Ground. Understanding these domains was detrimental to designing the application to facilitate user comprehension during analysis, which contributed towards an intuitive application.

### Development

The goal was to create a desktop application to enhance security as the client did not need access to a network for utilisation. Windows Forms.NET in Visual Studio was the development choice as it provided numerous built-in features and intuitive GUI capabilities. The development adopted an MVC (Model-View-Controller) architecture, a populated framework across application development that segregates multiple components, reducing the need for monolithic code.

To convert the data into visualisations, the ETL process was integrated that acts as a pipeline to clean and organise raw data for analysis. The ETL process began with extracting the data from the PDF file, then being manipulated and converted through the transformation, and lastly being loaded into charting visualisations. For this process, iTextSharp PDF library was adopted to meticulously maintain the positional layout and coordination of the text from the PDF file.

The application resulted in being a comprehensible solution that achieved an ETL process to manipulate structured data within a PDF file to populate a variety of charting visualisations. Users of this desktop application can simply import their inventory datasets to facilitate perception of how they comprehend the data to make informed decisions, such as discovering anomalies and predicting future trends. Adopting an iterative Agile approach, multiple prototypes were developed which compartmentalised individual sections to be completed incrementally. This allowed the developer to

render each development objective to a working execution which benefitted in maintaining the project's progress.

### Testing

User Acceptance Testing (UAT) was conducted at the end of the development cycle via Agile's iterative mechanism to determine whether the completed application was appropriate for its intended use case. UAT is an appreciated software development tool that is best used to test the product by having the intended audience utilise it in real life. Set tasks that reflected the user requirements were constructed and dispersed to the client. These comprised interacting with the application to detect any bugs or further refinements, to enhance the functionality and intuitiveness of the system. Additionally, two external users that have an affiliation with data reports carried out UAT to incorporate generalisability motives.

Overall, the application was effective in satisfying user demands and performed well in terms of clarity, usability, and data comprehension, with suggestions for enhancements that improve intuitiveness and analysis such as utilising a line graph to analyse trends by representing data over time, and applying hover features to facilitate perception issues.

### Conclusions and Recommendations

Through the use of data visualisations, the investigation pursued to improve user comprehension of inventory data, addressing the difficulties and implications that organisations encounter when interpreting and communicating such data. The project obtained important insights into DV techniques and HCI principles, particularly Gestalt Psychology by researching existing literature. These realisations guided the process of designing and developing the application, guaranteeing an intuitive interface and promoting understanding of the data through visualisations.

The application's primary goal of extracting and visualising inventory data was effectively accomplished, yet certain drawbacks were identified, including the inability to manage numerous PDFs and display a variety of inventory datasets. Nevertheless, the outcome of the investigation certified that visualisations help to simplify data comprehension, such as a column chart showing the distortion of the variance's positive and negative values.

Following studies may concentrate on mitigating these constraints and augmenting the application's ability to accommodate evolving user requirements, ultimately utilising HCI and cognitive principles to enhance user comprehension and decision-making.