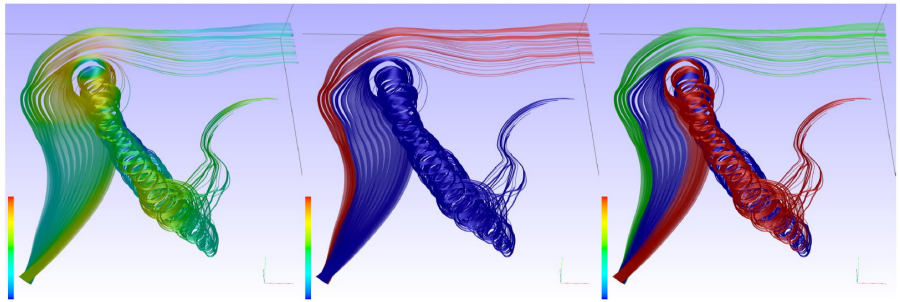
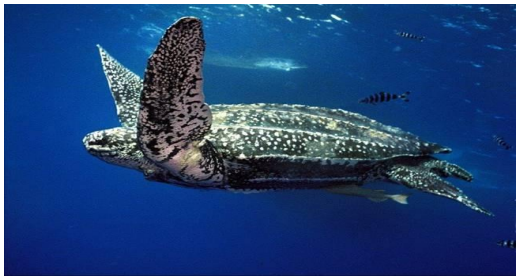
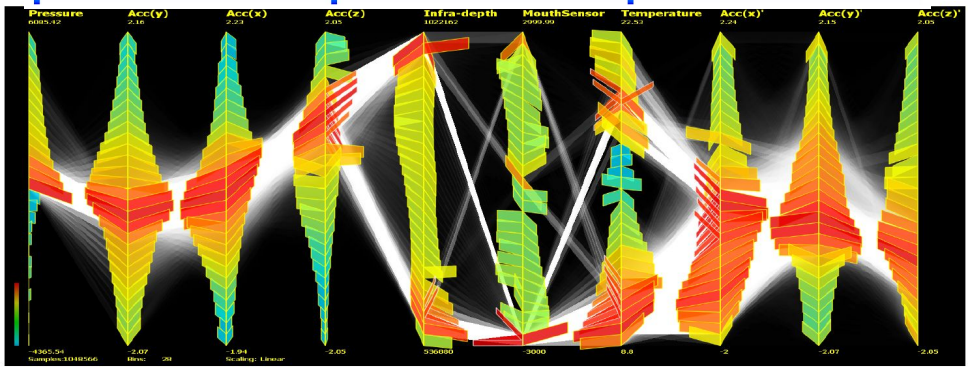
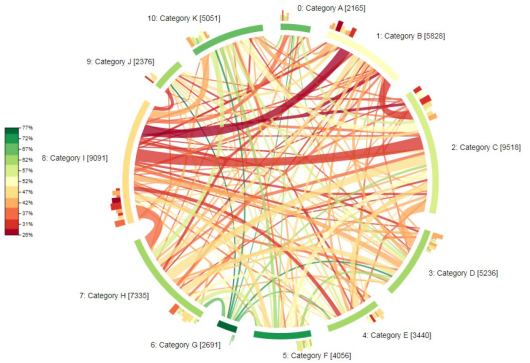
VisP2: The Visualization Project Process

Robert S Laramee
School of Computer Science, University of Nottingham
https://youtu.be/9NJsOB2grE4?si=qlY3SG1BAi_0mOEj

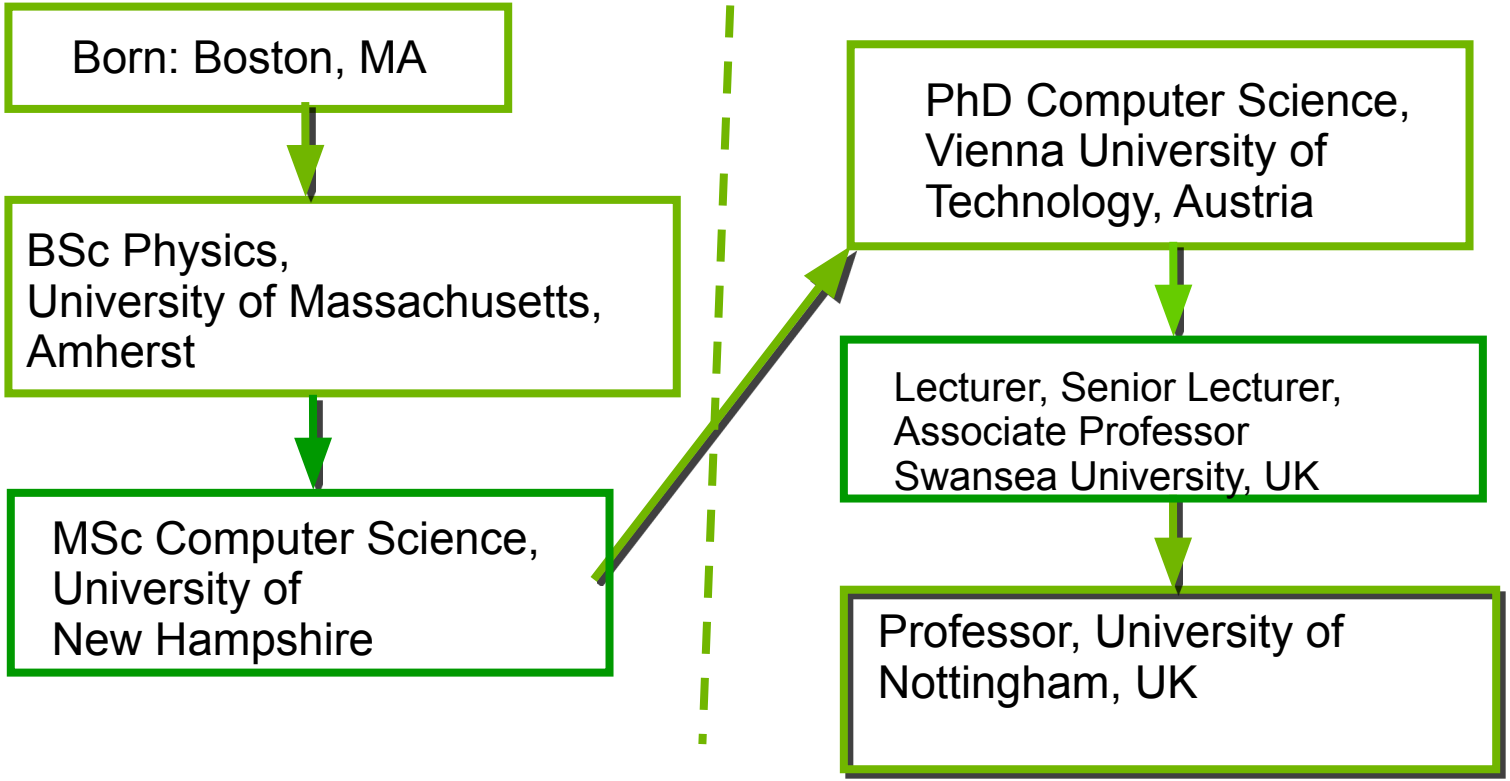








Bob's Background



http://eurovis.org.uk

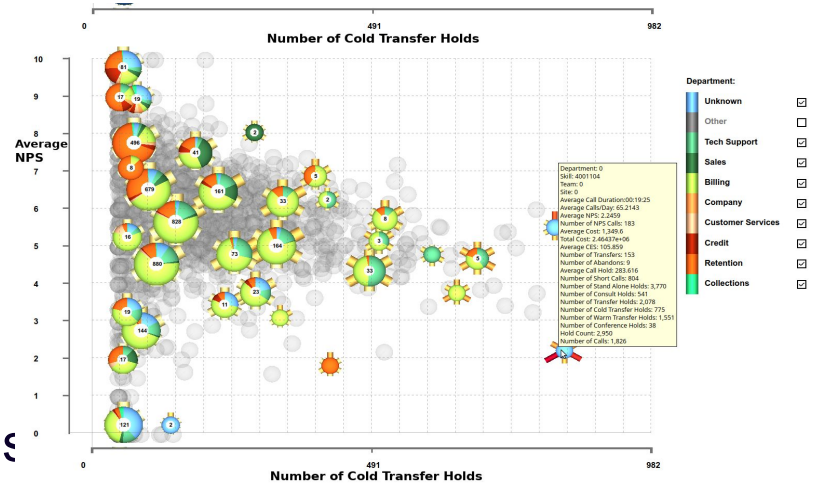
Introduction and Motivation

"*What is the Visualization Process?*"

"*What should we expect?*"

"*How does a visualization*

project work?"



Importance of topic grows over time as to inform decision making.

"*Trying to understand data without visualization is like trying to understand the world with your eyes closed.*" -Bob

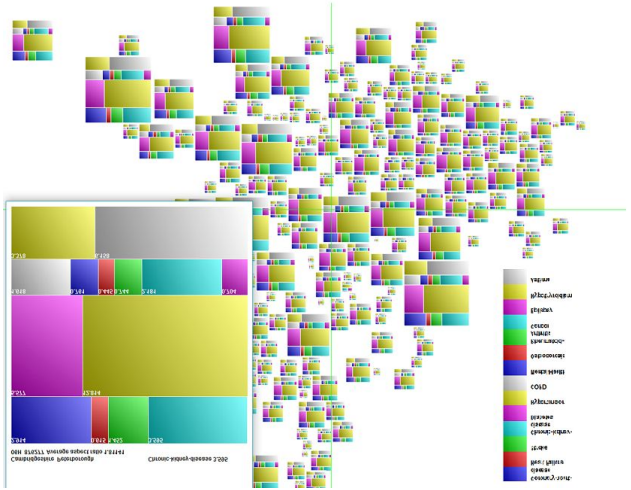
(Image courtesy of Dylan Rees)

A Basic, Typical Visualization Project Workflow

Based on hundreds of visualization projects over 20+ years, from a researcher's perspective

Contributions:

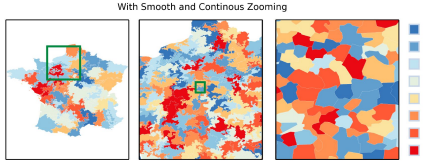
- Work pattern and strategy common to almost all visualization projects
- We offer guidelines, on overview of visualization life cycle, including some best practices and advice
- Useful starting point for anyone undertaking visualization project for first time or educators.
- Yes, it involves software engineering.



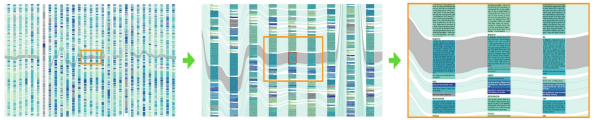
(Image courtesy of Chao Tong)

Some Visualization Projects

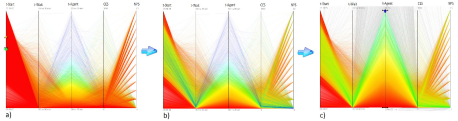
Smart City Visualization



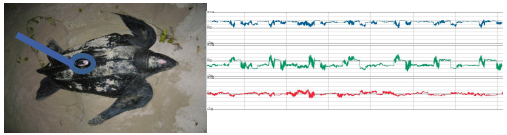
Visual Digital Humanities



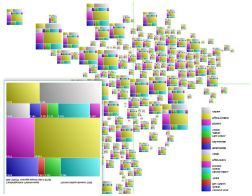
High Dimensional Visualization



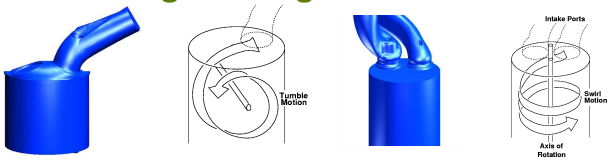
BioScience: Marine Biology and Animal Motion



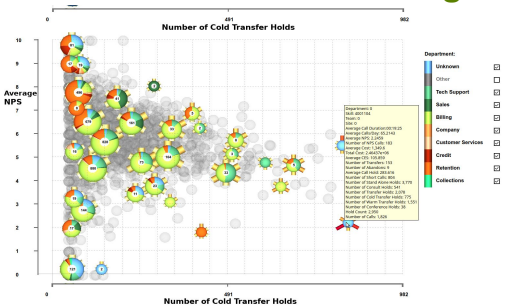
Visualization of Population Health Data



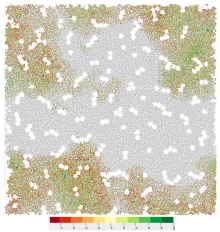
Virtual Engineering: Motor Simulation



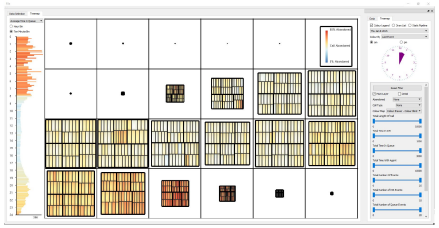
Business: Understanding Call Centers and Their Agents



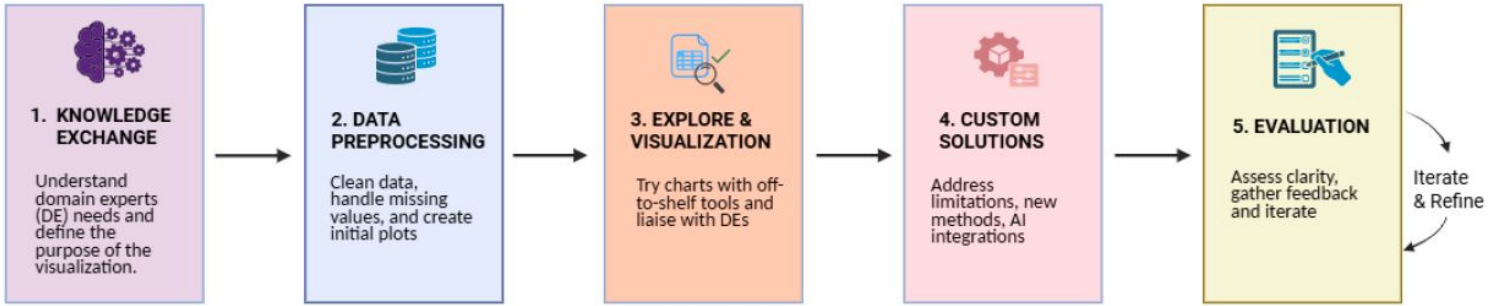
Computational Biology



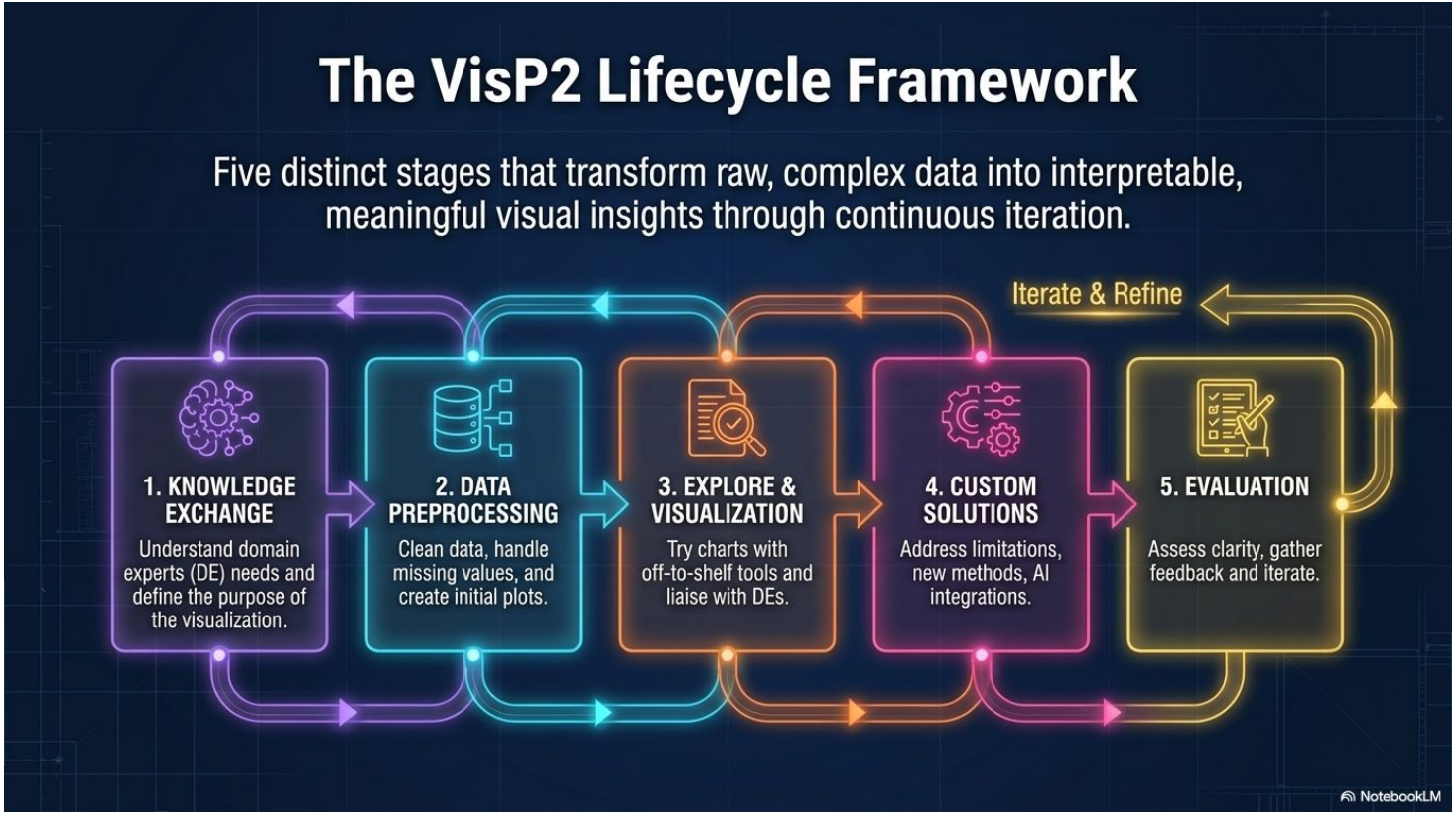
Data Visualization Literacy



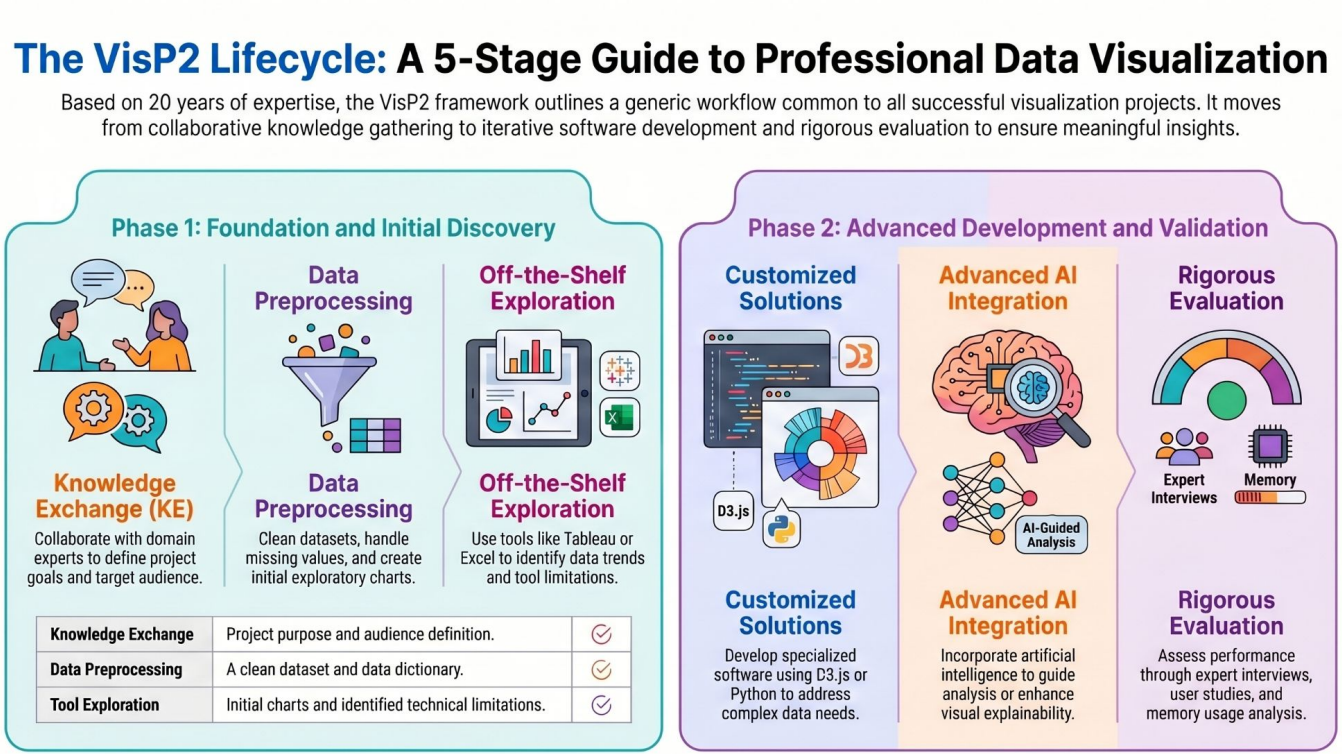
Overview of VisP2: The Visualization Project Process



Overview of VisP2: The Visualization Project Process (Slides)



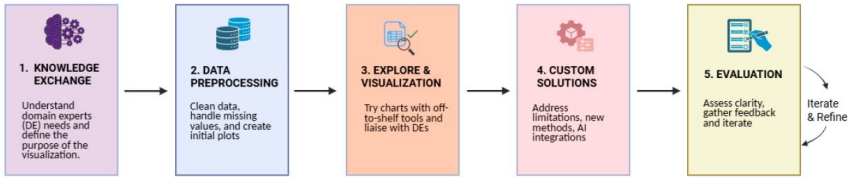
Overview of VisP2: The Visualization Project Process (Infographic)



Major Phase: Knowledge Exchange (KE)

Bi-Directional

- KE: Domain Expert (DE) → Visualization Scientist (VS)
  - Where does the data come from?
  - Why was it collected?
  - What questions are trying to be answered?
  - Purpose
- KE: VS → DE
  - Ideation
  - Overview **V**



Major Phase: Studying the Data

Data Understanding

Examining previous work

Building a data dictionary

First charts:

- Histograms,
- Scatterplots,
- Scatterplot matrices,
- Heatmaps

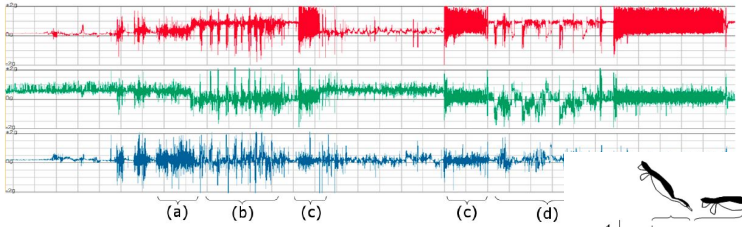


Figure 1: *Annotated acceleration data from an Imperial Cormorant. The three axes are prese showing the sway (red), heave (green) and surge (blue) data, over 33 minutes (vertical reference li of the signal have been manually identified by a biologist as (a) walking, (b) washing, (c) flying a*

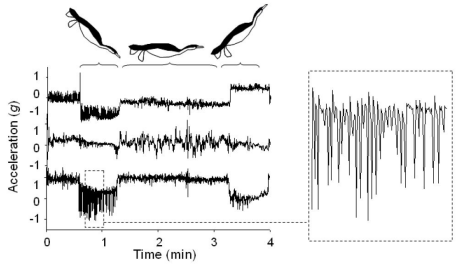
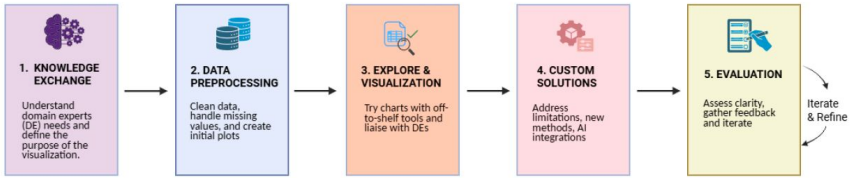


Figure 2: *Surge, sway and heave acceleration during a single cormorant dive. Changes in posture during descent, swimming, and ascent are evident as shifts in the baseline values of the surge and heave axes. Dynamic acceleration resulting from individual foot-kicks are identifiable as regular deviations from the static value, as shown in the insert.*

V

(images courtesy of Ed Grundy)



Major Phase: Explore and Visualize Data

Try Existing Tools e.g.:

- Google Sheets
- Tableau
- Power-BI

Explore Visual Design Space

Evaluate and Discover Limitations

What can we do better?

Table 7. Website References: A summary of the web pages and relevant resources described in Section Visualization-Focused Websites.

	Design Guidance	Blog(s)	Training	Events	Related Publications	Book Collections	Tools and Software	Data Sources	Case Studies	Related Web Pages
Depict Data Studio[59]	√	√	√	√		√				
DVS[60]	√	√	√	√	√	√		√	√	√
DVP[61]	√						√			
From Data to Viz[62]	√						√	√		
Information Is Beautiful.net[63]	√	√	√				√		√	
The InfoVis Wiki page[64]			√	√	√					√
Seeing Data[65]	√	√	√	√						
Tableau Public[66]	√	√					√	√	√	√
Data Vizualisation Catalogue[67]	√	√	√	√	√		√	√	√	√
Visual Vocabulary[68]	√		√							
Visualisingdata.com[69]	√	√	√				√		√	√
VRVis Conference Calendar[70]				√						
VizHub[71]	√		√				√		√	
Visualizing.org[72]	√	√		√			√	√	√	
OpenGL[73]	√		√	√			√	√		√
The Visualization Universe[74]	√					√	√			

collection of more than 1,000 data visualization related events since 1972.

The **VizHub**[71] is a website created by the Datavis Tech Inc providing courses and open source code examples for data visualization. VisHub also serves as an online tool to create and develop visualizations using web technologies such as HTML, CSS, JavaScript and JSX(React). In addition, the website can be used as an educational platform to produce an online course in data visualization.

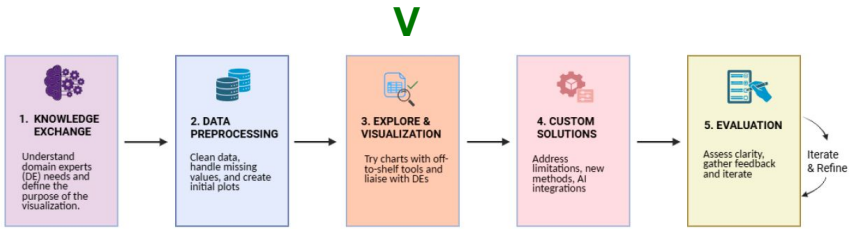
Visualizing.org[72] is an online community created by GE and the Seed Media Group. The website focuses on visualizing important events for designers, organizations, teachers and schools, as well as audiences who are trying to exploring data visualization and infographics.

OpenGL[73] is a graphics standard for developing portable, interactive 2D and 3D graphics applicatons. It was created

DVS[60] and VRVis[70] are recommended for practitioners who are interested in participating in activities such as meetings and visualization events and developing their professional network.

Free, Off-the-Shelf Software Collections for Data Visualization Practitioners

This section describes free off-the-shelf software for data visualization in practice. Since the start of visualization as a field, hundreds of software tools related to visualization have been developed. Due to the large volume, we do not list individual programs but rather collections of applications. Luckily, a few dedicated practitioners have worked very hard at curating an organized collection of off-the-shelf software collections.



Major Phase: Developing Customized Solutions

Develop specialized tool

Advanced Techniques

Developing Novel Solutions

- Overview
- Interaction
- Scalability
- High dimensionality

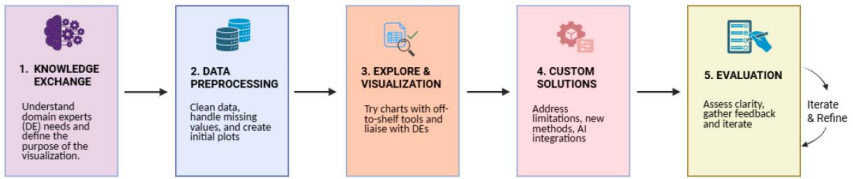
Table 8. Open Source Libraries: Software development library collections for visualization developers described in Section Open Source Library Collections for Developers. These resources feature a quality collection of free open source libraries.

Name of Library	Url
Awesome Dataviz Collection [1]	https://github.com/fasouto/awesome-dataviz
Awesome-D3 [82]	https://github.com/wbkd/awesome-d3
D3 tutorials [83]	https://github.com/d3/d3/wiki/Tutorials
Awesome Charting Collection [84]	https://github.com/zingchart/awesome-charting#readme
AntVis [85]	https://github.com/antvis
VTK [86]	https://vtk.org/
VisIT [87]	https://wci.llnl.gov/simulation/computer-codes/visit
Observable [88]	https://observablehq.com/

Table 9. Collections of Color Resources: A summary of the collections of color resources described in Section Collections of Color Resources and Section Noteworthy and Popular Color Resources. These resources feature a quality collection of color resources references.

Web Page Name	URL
Visualisingdata.com [69]	https://www.visualisingdata.com/
RapidTables [89]	https://www.rapidtables.com/web/color/index.html
SciVisColor.org [90]	https://sciviscolor.org/tools/
ColorBrewer.org [91]	https://colorbrewer2.org/
Colorgorical [18]	http://vrl.cs.brown.edu/color
Color Oracle [92]	http://colororacle.org/index.html
ColorHex.com [93]	https://www.colorhexa.com/
Adobe Color Wheel [94]	https://color.adobe.com/create
Chroma.js Color Palette Helper [95]	https://vis4.net/palettes
ColorPicker [96]	http://tristen.ca/hcl-picker
Data Color Picker [97]	https://learnui.design/tools/data-color-picker.html
hclwizard.org [98]	https://hclwizard.org/
I Want Hue [99]	https://medialab.github.io/iwanthue/

V



Major Phase: Evaluation (Context Dependent)

DE feedback and inteviews

Case Studies and Use Case Scenarios

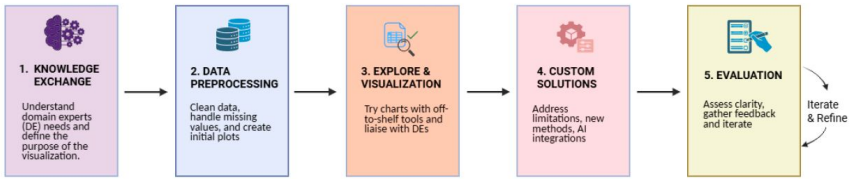
User Studies

Software Performance Evaluation

Memory Usage Analysis

Power Consumption

V



Conclusion

We present an experience-driven framework characterizing the full life-cycle of a visualization project

Typical phases are: KE, Data Processing, Testing Existing Tools, Developing Novel Solutions, Evaluation, Iterate

Process is usually collaborative

The landscape of evaluation is evolving

Acknowledgements

- Thank you for your attention.
- Any Questions?

References

Xiaoxiao Liu, Mohammed Alharbi, Jian Chen, Alexandra Diehl, Elif E Firat, Dylan Rees, Qiru Wang, and Robert S Laramee, **Visualization Resources: A Survey**, *Information Visualization*, Volume 22, Issue 1, pages 3-30, November 2022 (PDF file, web page, https://doi.org/10.1177/14738716221126992)

Engineering and Physical Sciences Resource Council (EPSRC UKRI157, APP17227, EPSRC EP/F002335/1)