Presenting Empirical Data

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ABSTRACT- *Technology professionals and students, especially those who are pursuing a specialization in science, engineering, and technology, should be able to understand the fundamentals and use of diagrams in explaining qualitative data. Through the use of one of the major categories of information graphics — the diagram — information is organized, designed, analyzed, visualized, and disseminated. While a great deal has been written about presenting quantitative data in the form of bar charts, line charts and pie charts, many engineering- and technology-related businesses and industries are still misinformed on how to best present empirical data.*

This paper addresses the best ways to present empirical data through the use of the diagram, a specific type of information graphic. The diagram is divided into three categories: (1) business diagrams, (2) technical diagrams, and (3) visual storytelling diagrams.

I. INTRODUCTION

Presenting empirical data through the use of images and words begins with determining what the overall message is and then determining the most effective and appropriate way to present the information. The target audience affects the decisions made about the graphic elements, the content, and the type of infographic chosen [2].

Diagrams focus on presenting complicated concepts and making them more understandable to the reader. This is done by presenting a process, an explanation, a chronology, a cycle, or an evolution. This may include such approaches as itemized labels and/or descriptions to parts of a machine, step-by-step processes, or a cutaway view. Rather than presenting numerical data in a graphic, the diagram presents empirical data and explains what, how, and/or why this information is important. Diagrams are most successful if the following components to the information graphic are included with the graphic: (1) headline, (2) explainer paragraph, (3) clear labeling, (4) the source of the information, and (5) the credit line.

It is important for professionals and technology students, especially those who are pursuing a specialization in science, engineering, and technology to understand the fundamentals and use of diagrams in explaining qualitative data. Through the use of one of the major categories of information graphics — the diagram — information is organized, designed, analyzed, visualized, and disseminated. While a great deal has been written about presenting quantitative data in the form of bar charts, line charts and pie charts, many engineering- and technology-related businesses and industries in are still misinformed on how best to present empirical data.

How content is presented aesthetically often determines whether or not the reader bothers to read the information design in the first place, even though “the message is king.” Without quality content, it would not matter how aesthetically pleasing the information graphic is. But there is one significant missing step — data analysis. Without interpreting the content and making decisions on what is to be presented, the wrong

message gets delivered. Often information designers are left to do the analysis. The job as an information designer is not only to pay attention to the details of graphic design, but also to spend a significant amount of time on making decisions on what part of the content will be delivered to the reader and how the content will be delivered.

Information graphics used as communication tools are significant to the decision-making process in an organization. Excluding a vital key point can result in a disaster such as the decision to launch the space shuttle Challenger on January 28, 1986 [3]. The relationship between the O-ring and the cool temperature caused the mission to fail. The engineers were not successful in convincing the NASA officials to postpone the launch in spite of the fact that they prepared 13 charts to make their case [3]. The information graphics were unconvincing and lacked appropriate documentation of who prepared the charts. The possible cause of concern (temperature) was not found in the analysis. The engineers came to the correct conclusion, but were unable to communicate the risk.

The fundamental guidelines of successful information design are condensed into three graphic design rules:

(1) Information design should be easy to read with clear and legible typography.

(2) It should have efficient visual flow. In other words, the layout should be designed to allow the reader to easily move from one element of the graphic to another in a logical order and in an efficient amount of time.

(3) The information design should be aesthetically pleasing to view.

This paper addresses the best way to present empirical data through the use of the diagram, a specific type of information graphic. The diagram is divided into three categories: (1) business diagrams, (2) technical diagrams, and (3) visual storytelling diagrams.

Venn Diagrams

The Venn diagram is an example used to show relationships and overlapping connections between sets of information. John Venn was a 19th century mathematician who made the Venn diagram famous [2].

The circle diagrams represent the relationships usually between two sets: (1) the records found exclusively in set 1, (2) the records found exclusively in set 2, (3) the records found in both sets, and (4) the records not found in either set. Figure 1 shows the intersection of three circles.

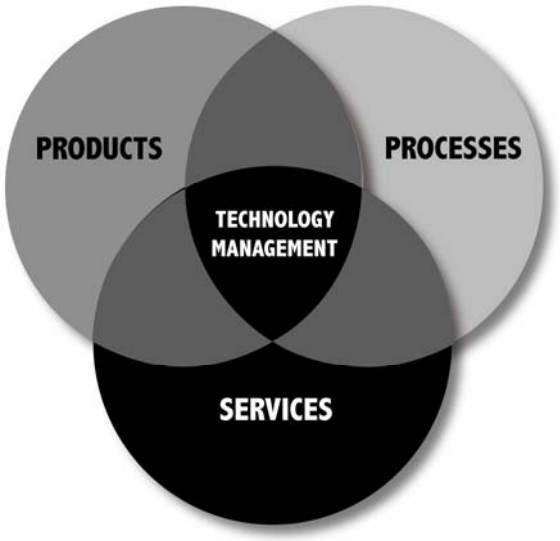

Figure 1. Venn Diagram with three circles

II. BUSINESS DIAGRAMS

Business diagrams are used to communicate how organizations are organized, how work flows, and how much time and resources are needed to complete a project. Organizational charts, Gantt charts, and flow charts are information graphics that are used by businesses.

a. Organizational Charts

Organizational charts illustrate the management hierarchy of employees in an organization. The head of the organization is at the top of the chart with the next level of management on the second tier. Lines are used to indicate who is managing what areas of a company, and the reporting architecture.

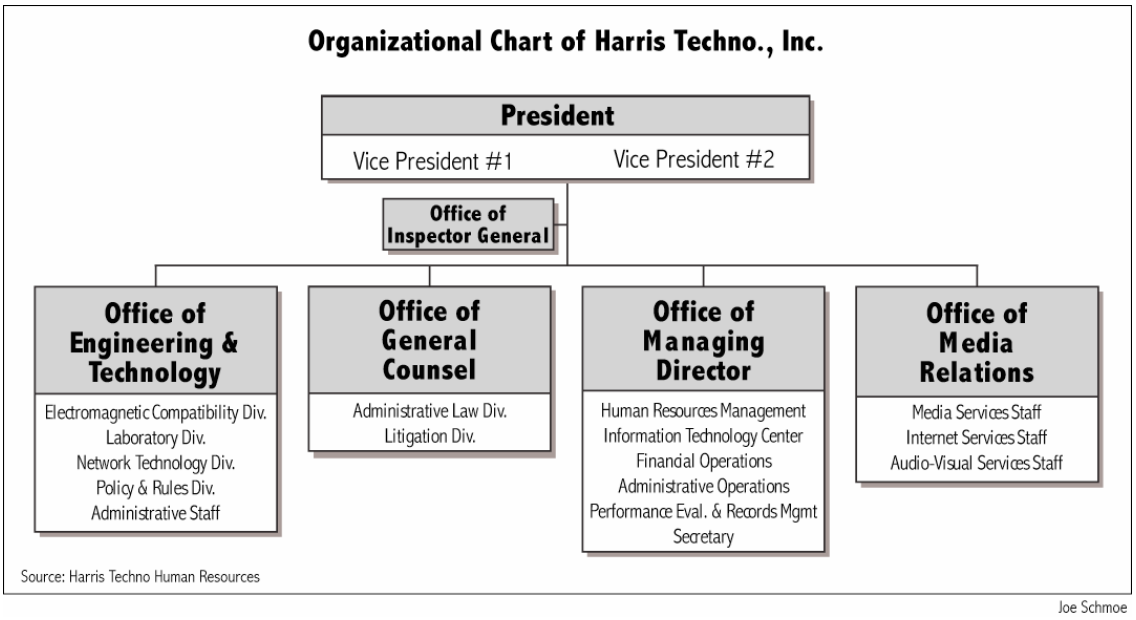

Figure 2. Organizational Chart

b. Gantt Charts

Gantt charts are a useful production tool for an organization. The Gantt chart visually illustrates the tasks, time, and resources allotted to complete the tasks to a project. The Gantt chart is often used in proposals. Microsoft Project and SmartDraw software Suite Edition (Gantt Chart and Calendar Edition) are software used to create this type of chart.

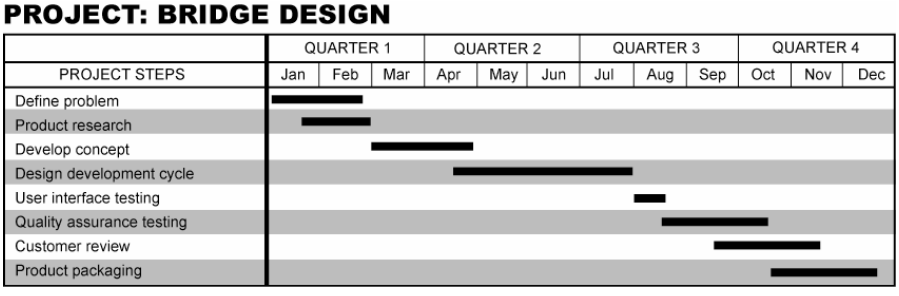

Figure 3. Gantt Chart

c. Flow Charts

Flow charts are quality improvement tools used to document, plan, or analyze a process or series of tasks. Almost all quality improvement diagrams have evolved from the flow chart, such as the cause and effect diagram, the Pareto chart, and the histogram. Detailed flow charts, workflow diagrams, top-down flow charts, and deployment charts are types of flow charts.

A flow chart is a diagram of a step-by-step process using geometric symbols that represent specific activities. Oval shapes symbolize the beginning and end of a process. Diamond shapes symbolize decision points of tasks.

The purpose of a flow chart is to define and analyze a process, build a visual picture of the process, standardize a process, or improve a process. These activity diagrams illustrate typical business processes that synchronize external incoming events for an organization. They are used most often for analyzing workflow, documenting decisions and iterations, and finding reengineering opportunities. They are also used to display the actions performed, the parallel/random behavior, and the iterations of the processing. A process diagram is a flow chart. When a schematic diagram is made into a sequence graphic, it also becomes a flow chart.

Software used to create flow charts includes ABC Flow charter, Corel Flow, and Visio.

III. TECHNICAL DIAGRAMS

A technical illustration is defined as “any visual presentation which has the purpose of communicating technical information intended to aid in the design, manufacture, assembly, storage, distribution, use, disassembly, or disposal of a product or process” [4].

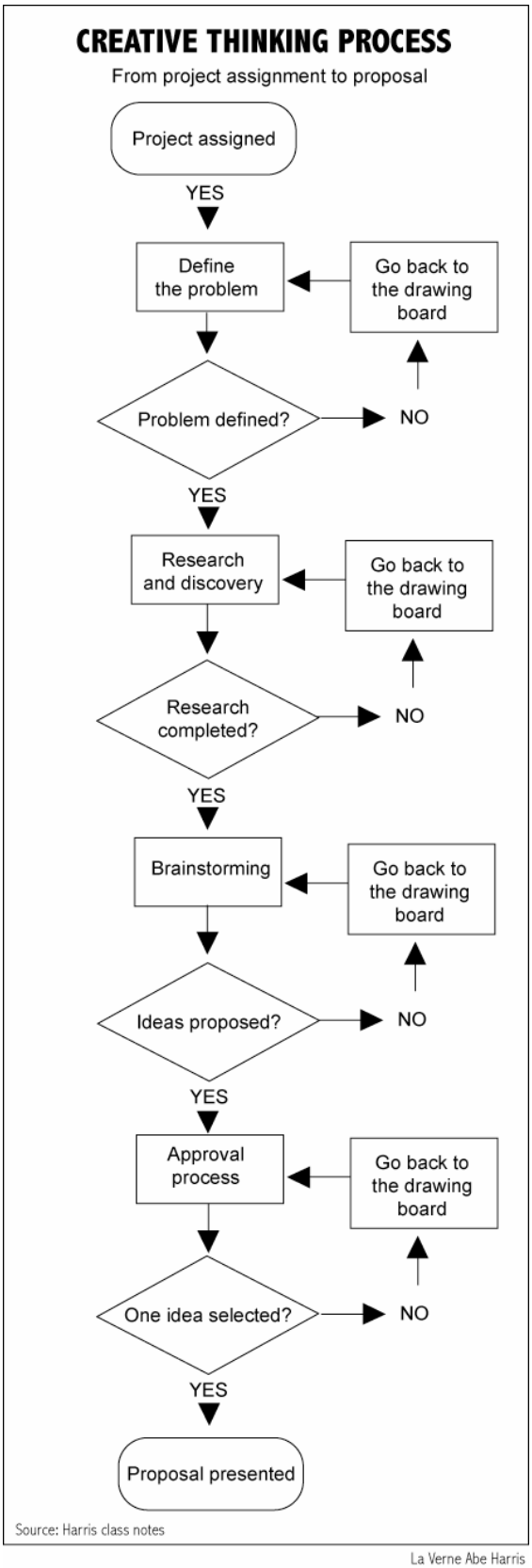

Figure 4. Flow Chart

Figure 5. Technical illustration without labels

Schematic Diagrams

Schematic drawings are used as information graphics to explain how components work together, what the measurements are, how components are set up, or how pieces are connected. They are essentially the blueprints for a prototype. Schematics explain system relationships, such as circuit diagrams and blueprints. Organizational charts have also been categorized as schematic diagrams. Hierarchical organization makes a schematic into an information graphic [5]. A schematic diagram can show how parts fit together [6].

Instructional Diagrams

Instructional diagrams are information graphics whose purpose is not to explain how the overall system works, but how a specific action within the object occurs. This is done through highlighting the one action with a visual clue and text, such as a pointer box or an arrow. Realistic renderings of the object are usually used [5].

Pictorial Views and Assembly

Pictorial assembly information graphics demonstrate how components are assembled. The drawings usually consist of an unassembled drawing and an assembled one for technical documentation. An alternative approach is the exploded view, which is a way to deconstruct an object [6].

Cutaways

Cutaways allow the reader to see a slice of an object. Cutaways show the relationship between the inner workings and the outer image of an object [5]. A cutaway diagram can also show layered views and hidden views that the use of photography would not be able to accomplish as well [3].

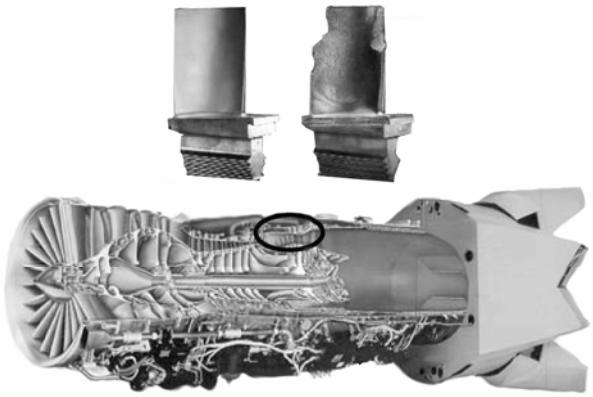

Figure 6. Cutaway diagram

Photography for Technical Documentation

Sometimes photographs are used instead of charts or drawings for information graphics. These are often suitable for inclusion in technical documentation. When

a photograph is combined with digital artwork to make an editorial point, it is viewed as an illustration. In either case, a photograph should have a caption to explain why it is significant [7].

IV. VISUAL STORYTELLING DIAGRAMS

Maps, Explanation Diagrams, Sequence Diagrams, and Sidebars

Visual storytelling diagrams are information graphics that can display empirical data or they can just further clarify or emphasize information. Diagrams contain visuals and/or text that are used to explain an idea, offer a step-by-step process, show historical events, show profiles, or geographically locate information. Usually the graphic element takes up the majority of the space.

When a small information graphic is embedded in the layout of the article to further explain the story, it is referred to as a sidebar. Sometimes these sidebars consist of tips, explanations, or background information. Sometimes they contain visuals; other times they are just words. Words can stand on their own as information graphics, as long as they are presented in a visually pleasing manner. Typography is a visual element when presenting content.

When engineering proposals are written or ideas presented to large audiences, it is important to know that presenting empirical data, rather than number content, fall into these types of diagrams: (1) maps, (2) explanation diagrams, (3) sequence diagrams, and (4) sidebars.

Maps

Maps are information graphics that usually display the location of events with the geography. Since many Americans are "geographically-challenged," it is helpful to include a map in a document to show the location of a key place. A map can also be used to present the geographical distribution of data, or to explain a step-by-step series of events at different locations. Be sure that the map is oriented so that north is pointing to the top of the information graphic. Add an arrow and "N," if it is appropriate and not obvious to the reader [8]. MapArt Geopolitical deluxe for USA and World on CD is a good resource of digital files for locator maps, if you do not create your own maps from Adobe Illustrator [9].

Figure 7. Map

EXPLANATION DIAGRAMS: Depiction Diagrams

When you demonstrate how something works on paper, explain a basic process, or deconstruct an object, a plan or drawing, you create an explanation diagram. Depiction graphics describe and simplify factual information on what the real-world system is. Depiction diagrams do this by presenting the key points through the use of realistic images of actual objects. Depictions are generally used to describe how the overall system works, or compare and contrast the key differences between systems [5].

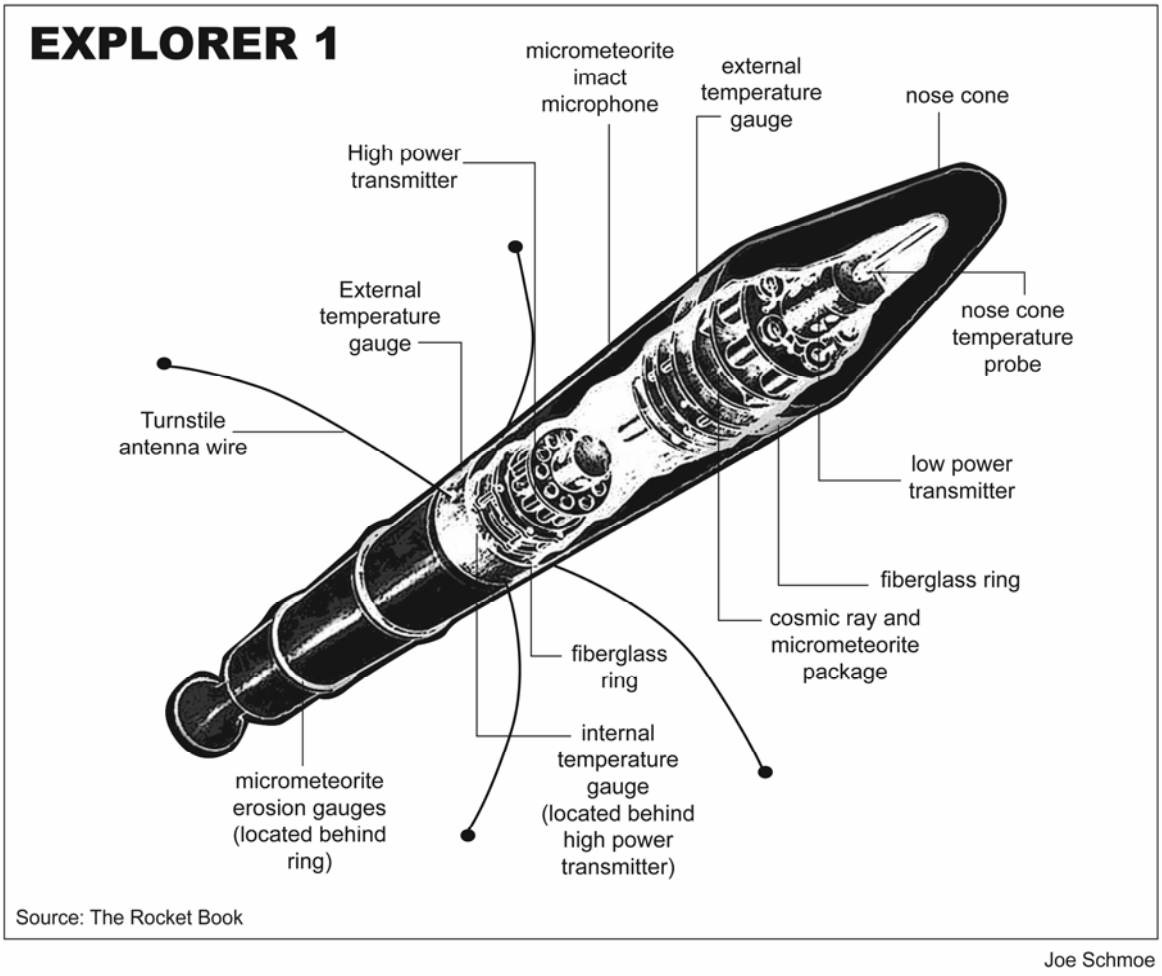

Figure 8. Depiction graphic

SEQUENCE DIAGRAMS: Process Diagrams

A process graphic explains how system elements work and how interactions occur. It should tell a story and should present the process in an accurate and simplified manner with labels, pointers, and explainer blurbs of text [5]. Often only part of a process is explained. If the entire process is presented, it is important to make decisions on the priority of the information. The designer should not try to tell the whole story — just the most relevant parts.

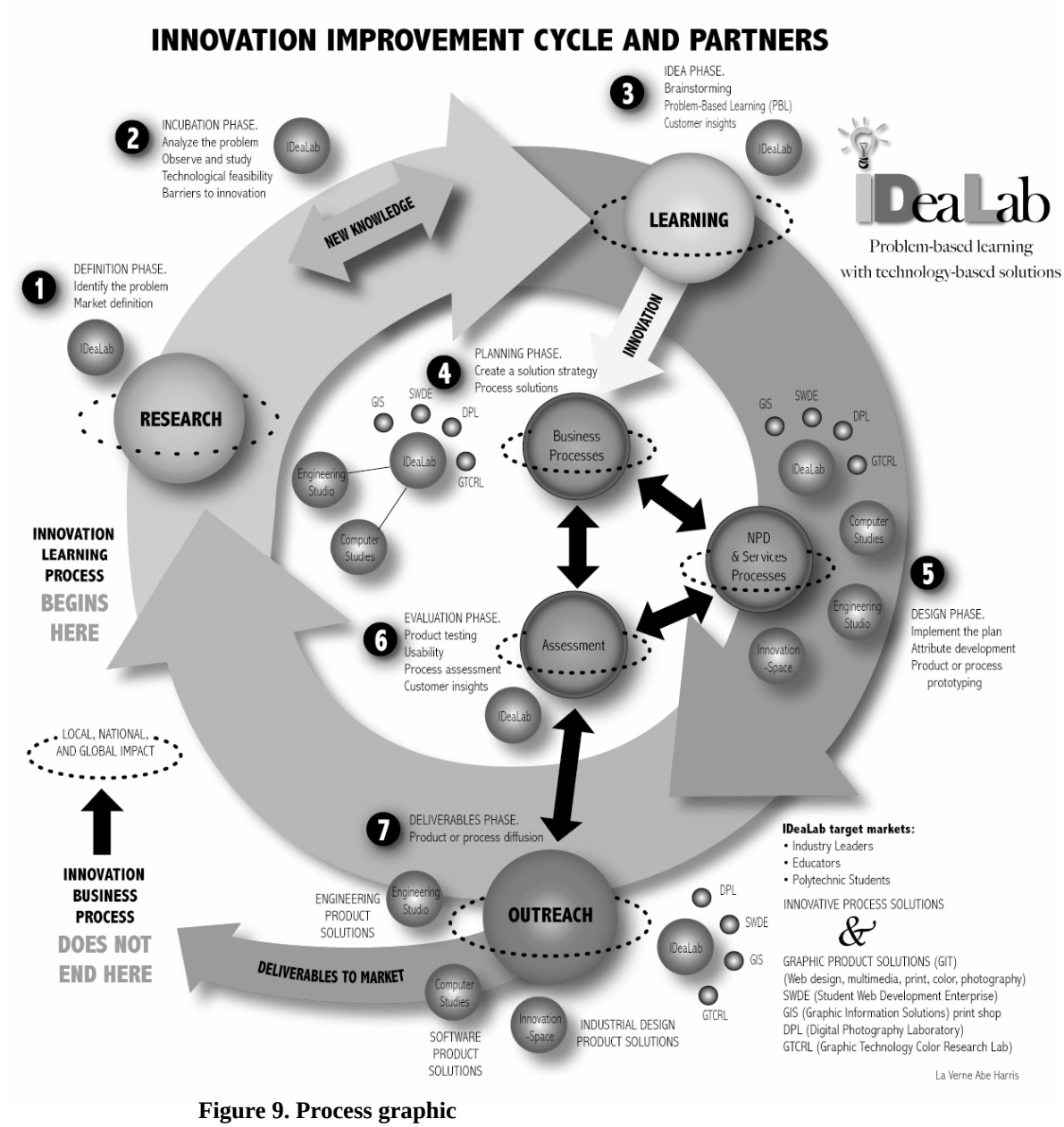

Figure 9. Process graphic

SEQUENCE DIAGRAMS: Timeline

When you need to highlight significant moments in history, a timeline is the choice for presentation. A timeline is a chronological table or list of events presented in a graphical way. Adding photographs and graphical icons to timelines are options. The most important thing to remember is to use consistent scales

[5]. Showing a sequence of changes over time "is identical to showing adjacent layers of information" and "paper, time and space are as one" [3].

SEQUENCE DIAGRAMS: Step-by-step Guides

When a complex process needs to be explained, a "how to" brief that takes the reader through the process one step at a time, is the step-by-step guide.

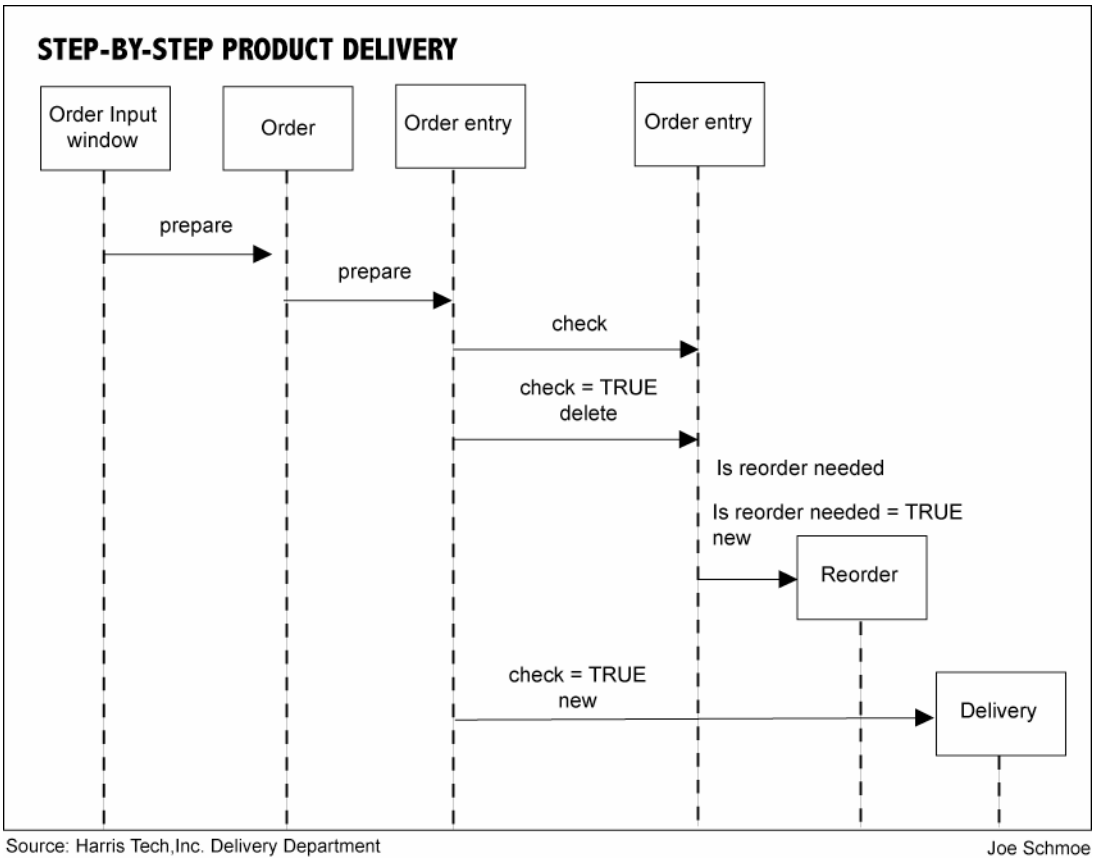

Figure 10. Step-by-step diagram

SIDEBARS: Briefs

Briefs and lists present word content alone, rather than number content. Small snippets of factual information selected from the proposal to give readers a brief grasp of who, what, when, where, and why, are called "briefs." Sometimes these information graphics are called "glimpses."

SIDEBARS: Lists

Additional content to a written proposal or presentation that includes a series of components, definitions, tips, etc. is called a list. This information can be bulleted. It also can be pulled out of the proposal and boxed.

Glossaries, checklists, quotes, FAQs (Frequently Asked Questions), and Q&As (Questions and Answers) fall into this category.

A list of terms with definitions to help clarify specific topics is referred to as a "glossary." This is also considered an information graphic. A "checklist" of questions or guidelines is a type of list, as well. Relevant quotes on a topic that are pulled from the proposal or article and displayed in a visually-pleasing manner are also information graphics. FAQs and Q&As are types of

information graphics to further explain concepts, processes, or procedures in words. This list of questions can also let readers engage with a story by furthering their understanding of the topic [8].

SIDEBARS: Bio Profiles

Brief boxed profiles of people, products, projects, organizations, or locations, with details of significant characteristics, are called “bio profiles” or “bio boxes.” This usually includes a small graphic.

V. CONCLUSIONS

Many engineering- and technology-related businesses and industries can benefit from applying the appropriate use of diagrams to present empirical data. Through the successful organization of content — both words and graphics — the diagram becomes a vital tool to the decision-making process in an organization.

VI. REFERENCES

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