POLICE LEADERSHIP AND INFORMATION DESIGN
APPLYING GRAPHIC EXCELLENCE
TO THE LAW ENFORCEMENT MISSION

by

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The Command College Futures Study Project is a FUTURES study of a particular emerging issue of relevance to law enforcement. Its purpose is NOT to predict the future; rather, to project a variety of possible scenarios useful for strategic planning in anticipation of the emerging landscape facing policing organizations.

This journal article was created using the futures forecasting process of Command College and its outcomes. Defining the future differs from analyzing the past, because it has not yet happened. In this article, methodologies have been used to discern useful alternatives to enhance the success of planners and leaders in their response to a range of possible future environments.

Managing the future means influencing it—creating, constraining and adapting to emerging trends and events in a way that optimizes the opportunities and minimizes the threats of relevance to the profession.

The views and conclusions expressed in the Command College Futures Project and journal article are those of the author, and are not necessarily those of the CA Commission on Peace Officer Standards and Training (POST).

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"Flight controllers here looking very carefully at the situation. Obviously a major malfunction. We have no downlink."--NASA Mission Control, upon the explosion of Space Shuttle *Challenger*, 73 seconds after launch, January 28, 1986 [1]

"I made inquiry, in detail, respecting the eighty-three deaths registered as having taken place during the last three days of the week…On proceeding to the spot, I found that nearly all the deaths had taken place within a short distance of the pump."—Dr. John Snow, in his report on a cholera outbreak in London, 1854 [2]

What do the Challenger disaster and the 1854 London cholera outbreak have in common, and what can law enforcement leadership learn from these catastrophes? For students of Information Design, both are examples of the power of Information Design to sway opinion, to influence decisions, and inform life-or-death decisions. Each was a catastrophe, staggering in its scope and in its time in history. In one, poor information design helped lead to disaster. In the other, it led to remedy and discovery.

The visual presentation of information can be a powerful means of persuasion, compelling in its ability to tell a story, and capable of exerting strong influence upon elected officials and policy makers. Yet it is rarely mentioned in our profession, thus it is under-utilized and under-appreciated. At what cost? By becoming aware of the power of smartly designed graphical data, law enforcement leaders stand to increase their influence, strengthen their arguments, and advance professionalism in their work. More importantly, when leading an agency and community through crises, police leaders adept use of Information Design may be the fulcrum upon which the outcome rests. We will

explore the art and practice of Information Design and learn about its power to impact and influence public policy. Leveraging easily understood concepts of graphical excellence, law enforcement professionals stand to better scrutinize and evaluate new and developing data display technologies. To begin**,** consider a term rarely heard in law enforcement, and learn how its power can be used in the service of public policy as well as public safety.

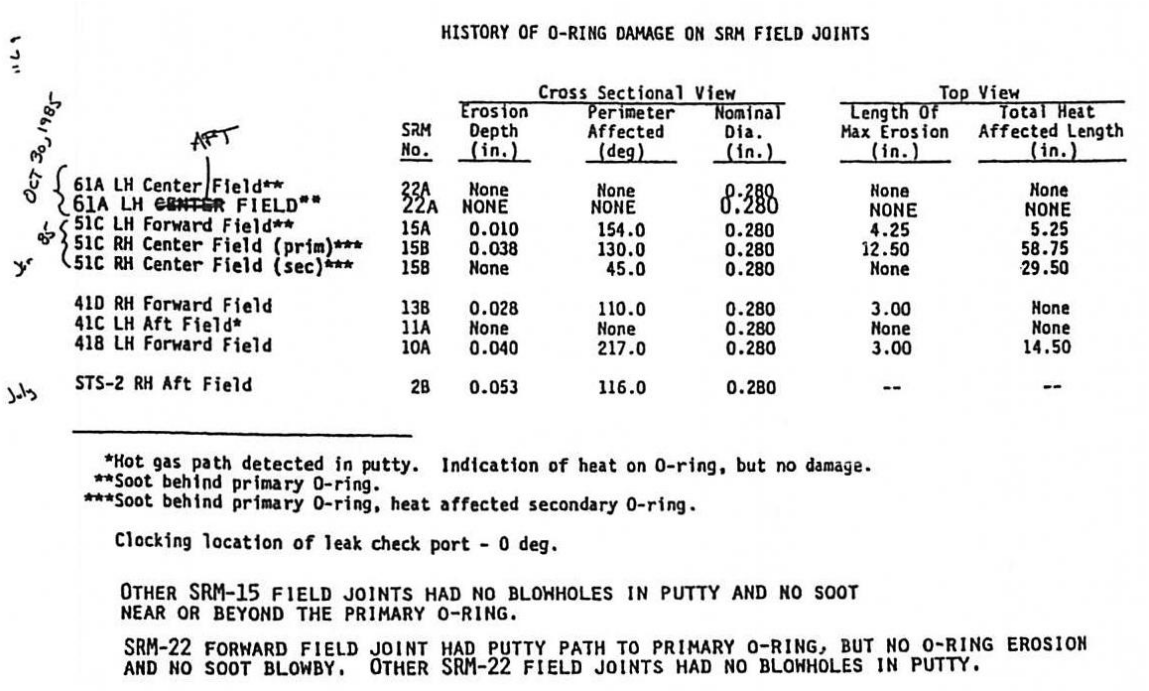
What is Information Design?

Information Design has been described as "the art and science of preparing information so that it can be used by human beings with efficiency and effectiveness." [3]; the purpose of which is "the systematic arrangement and use of communication carriers, channels, and tokens to increase the understanding of those participating in a specific conversation or discourse." [4] Information Design can be thought of as a discipline or practice which presents information in the form of data graphics—charts, graphs, maps, and illustration—"for helping people find their way around in complex settings."[5] Information Design involves critical thinking, data analysis, and understanding how viewers interpret graphical information. Although Crime Analyst professionals may focus on some aspects of design in their charts, tables and maps, the topic is conspicuously absent from the law enforcement literature [6]. Police executives and managers may be passive consumers, unaware of Information Design's ubiquitous presence… and its power. It can be thought of as a powerful tool in the kit of a law enforcement professional, albeit one that is underappreciated and underutilized.

In every chart, graph, table and illustration, Information Design is in play. But do we in law enforcement harness it to serve our specific goals? Do we recognize the impact Information Design has? Do our data graphics bring clarity and understanding to our personnel, to our policy-makers, to our communities? Like the air we breathe, Information Design surrounds us. In its deficit, we are left confused, unable to think and reason clearly. Where it is abundant, it has the capacity to help all see more clearly, to influence decisions for the common good, and enhance the legitimacy of our organizations in our communities. The power of information design can be seen in the context of an Information Design expert's case studies of two catastrophes separated by more than 130 years: The loss of the Space Shuttle Challenger, and the epidemic spread of cholera in 19th century England.

The Challenger

On the day before its launch, Space Shuttle *Challenger* engineers argued with NASA officials against launch. Presentation of information was presented in opaque language, populating columns and rows of text. [Fig. 1]



HISTORY OF O-RING DAMAGE ON SRM FIELD JOINTS

	SRM No.	Cross Sectional View: Erosion Depth (in.)	Cross Sectional View: Perimeter Affected (deg)	Cross Sectional View: Nominal Dia. (in.)	Top View: Length Of Max Erosion (in.)	Top View: Total Heat Affected Length (in.)
61A LH Center Field**	22A	None	None	0.280	None	None
61A LH CENTER FIELD**	22A	NONE	NONE	0.280	NONE	NONE
51C LH Forward Field**	15A	0.010	154.0	0.280	4.25	5.25
51C RH Center Field (prim)***	15B	0.038	130.0	0.280	12.50	58.75
51C RH Center Field (sec)***	15B	None	45.0	0.280	None	29.50
41D RH Forward Field	13B	0.028	110.0	0.280	3.00	None
41C LH Aft Field*	11A	None	None	0.280	None	None
41B LH Forward Field	10A	0.040	217.0	0.280	3.00	14.50
STS-2 RH Aft Field	2B	0.053	116.0	0.280	--	--

*Hot gas path detected in putty. Indication of heat on O-ring, but no damage.
**Soot behind primary O-ring.
***Soot behind primary O-ring, heat affected secondary O-ring.

Clocking location of leak check port - 0 deg.

OTHER SRM-15 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY AND NO SOOT NEAR OR BEYOND THE PRIMARY O-RING.

SRM-22 FORWARD FIELD JOINT HAD PUTTY PATH TO PRIMARY O-RING, BUT NO O-RING EROSION AND NO SOOT BLOWBY. OTHER SRM-22 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY.

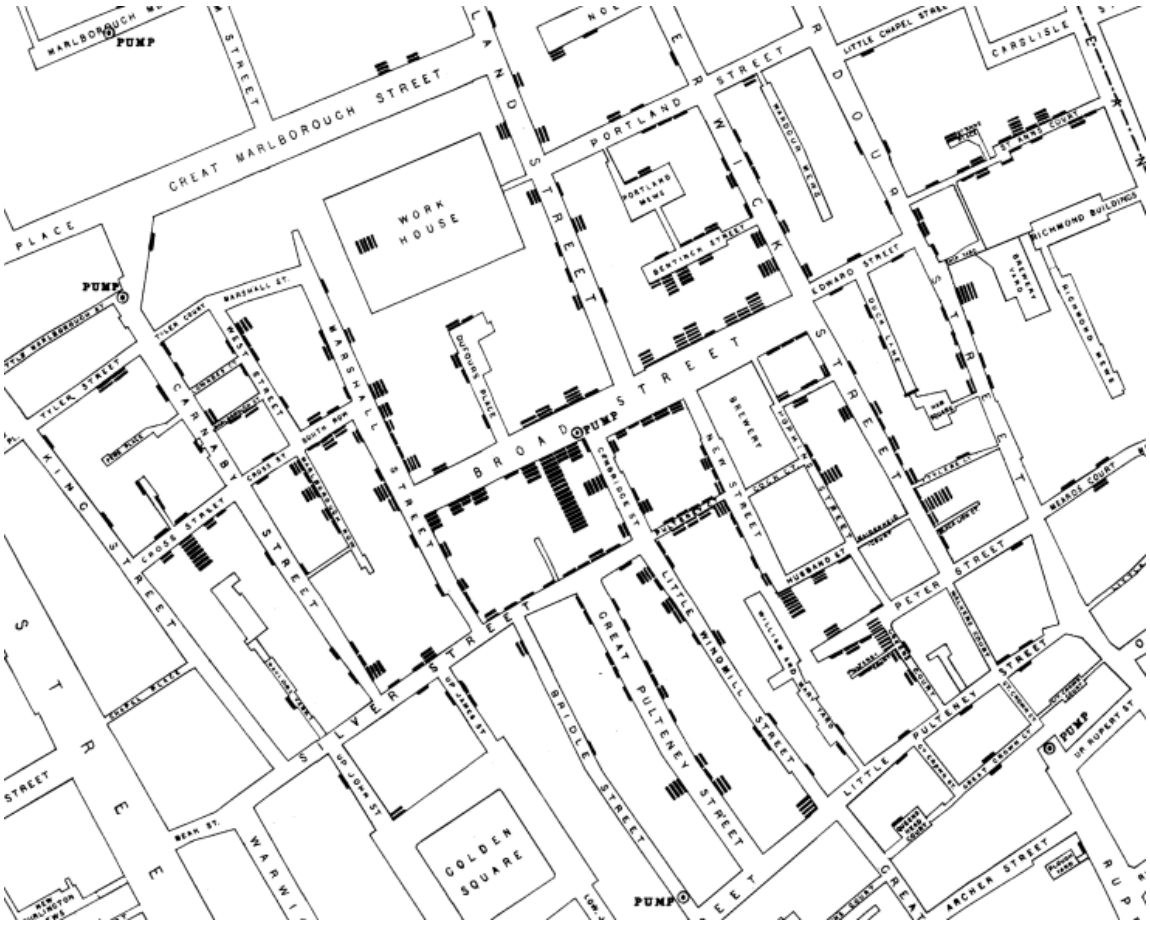
As noted in Edward Tufte's case study of the Space Shuttle, "On the day before the launch of Challenger, the rocket engineers and managers needed a quick, smart *analysis* of evidence about the threat of cold to the O-rings, as well as an effective *presentation* of evidence in order to convince NASA officials not to launch." (7, *italics original]*

Their presentation proved ineffective. The experts were unable to persuade the decision makers. NASA officials, unmoved by the *presentation* of information, decided to launch on January 28, 1986, the coldest day (*by more than 20 degrees*) in Shuttle launch history. As history revealed, critical rubber O-rings on one of the two booster rockets, made brittle and stiff by the severe cold, failed in the first moments of launch, dooming the seven astronauts aboard. Just over a minute later, fuel leaking through the compromised O-rings ignited, and the Challenger exploded. Although many lament the tragedy, and may also see the shortcomings of NASA's decision-making process, few might suggest an alternative. As will be seen, different information design approaches

could have produced a radically different outcome. A lesson from history provides an example of how graphical data, presented in a clear and understandable manner, produced a desired change in public policy, and a positive outcome.

The London Cholera Epidemic

In 1854, a cholera outbreak in London, England killed more than five hundred people in ten days, and would likely have killed many more had not so many fled the area in panic (8). The means of transmission of cholera were unknown at the time. Dr. John Snow was a keen investigator, a critical thinker, a detective of sorts, and a pioneer in the study of epidemiology. Snow suspected cholera was spread through the water supply. He gathered high quality data—i.e. detailed information about as many victims and their drinking supply habits as he could. He mapped the residences of the dead, piling line upon line to indicate multiple fatalities per address. He thus constructed a data graphic displaying pertinent information in an easily understood format. This uncomplicated but rich data graphic showed a concentration of death near the Broad Street pump, a locally favored source of water, and, not coincidentally, the center of choleric deaths in the area. [Fig. 2]



An astute critical thinker, Snow probed deeply into all of the available data. While investigating deaths occurring further away from the epicenter, he determined that most of those stricken turned out to have routinely obtained their drinking water from the same Broad Street pump. Through considering all available data, and capturing his findings in an easily-understood map, Snow created a starkly powerful work of information design, which illustrated the correlation between cholera and the water source, the Broad Street pump.

Snow presented his map and investigation to local officials—a bold action of informing public policy in that time of crisis—and convinced them to remove the pump handle the next day. [9] Snow's data graphic advanced an understanding of the spread of

cholera, thus preventing the loss of lives in the future. His work proved a seminal moment in the study of epidemics.

Though with wildly different outcomes, in both the Challenger incident, and the Broad Street cholera outbreak, experts worked to identify which data were critical to consider, and then to present their findings to decision makers—to advance an argument of correlation, identifying vital cause and effect. In his work studying the Challenger disaster and Snow's cholera investigation, Edward Tufte illustrates the potential Information Design has to affect public policy and the decision-making policy.

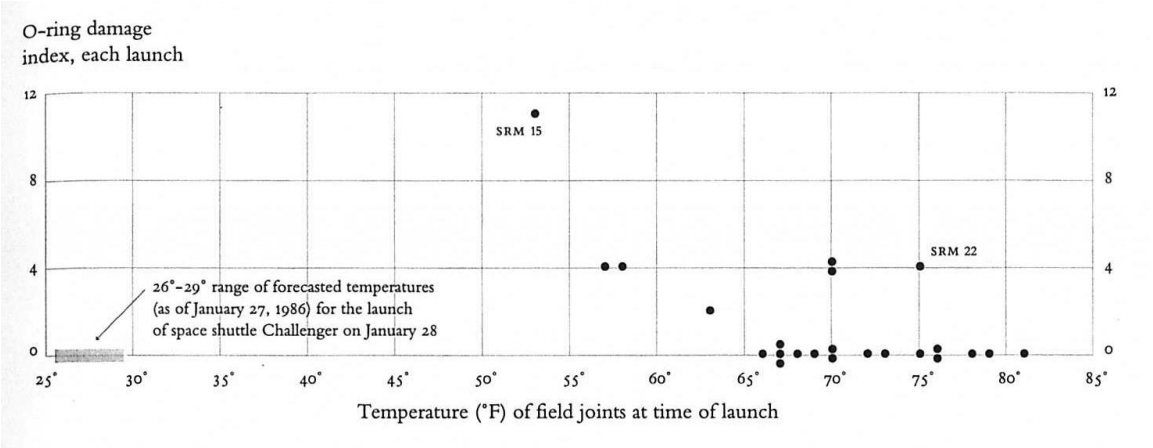
Edward Tufte and Information Design

"There are right ways and wrong ways to show data; there are displays that reveal the truth and displays that do not." [9]

Called "the world's leading information designer," [10] author, Yale Professor (emeritus) Edward Tufte lectures across the country on statistical evidence and information design. In *Visual Explanations,* Tufte closely examined both the presentation of the data and the actual evidence used during the critical launch/no-launch discussion preceding the Challenger's 1986 launch. He found the presentation of the evidence by technical experts obscured the critical link between temperature data and O-ring "erosion" data for the decision-makers receiving it. The engineers and managers used thirteen opaquely worded charts to try to persuade NASA management to postpone the launch. None of the charts were persuasive on their own, or in the aggregate. Critical information was buried in inscrutable, specialized language, and laid out in poorly

designed tables. The next day, the very failure engineers anticipated occurred, and the mission was lost.

Tufte extracted data from the information to develop his own data graphic. He took the O-ring damage results from the previous 24 launches, and plotted them against the launch temperature for each mission. [Fig. 3]



The resulting data graphic correlates damage to temperature, making a persuasive argument to not launch. In every launch in less than 66-degree weather, the O-rings were damaged. The damage was severe at 50 degrees. The temperature on the day of the Challenger launch was 29 degrees. Tufte's data graphic makes clear "the stupendous extrapolation beyond all previous experience that must be made to in order to launch at 29 degrees." [11] In that gap between *how* information was displayed during the argument, and how it *could've* been displayed, lives were lost.

Tufte's assertion, that the Challenger tragedy could have been averted had a superior data graphic been presented, is supported by consideration of how Snow's map more than a century earlier brought clarity and understanding to a dire situation. Snow's map grew out of the confluence of several factors, not unlike those in a criminal investigation: He had a theory which informed his investigation, he gathered information

that connected cause and effect; he compared and analyzed measurable data, and he considered alternative explanations for what had transpired. Little differentiates Snow's evidence-based approach in 1854 from the approach used by investigators and law enforcement executives in modern times.

Consider the integral role law enforcement leaders play in shaping public policy. Whether policy or budget, crime issue or community improvement, law enforcement officials must first identify the critical data, and then present it in such a way that a persuasive argument is made. The importance of choosing powerful graphic displays cannot be overstated.

Applying Graphic Excellence in Law Enforcement

"What is to be sought in designs for the display of information is the clear portrayal of complexity. Not the complication of the simple; rather the task of the designer is to give visual access to the subtle and the difficult—that is, the revelation of the complex." E. Tufte [12]

Law enforcement leadership is entrusted with wisely informing public policy through truthful and accurate reporting and analysis. This information frequently takes the form of data graphics, whether charts, graphs, density or hot-spot maps, or other illustrations. These data graphics are used to report and compare crime levels, describe budgets, and illustrate problems and strategies, and more. If an agency's data graphics are relied upon to inform, influence, and persuade governing officials, focus on what Tufte calls "graphical excellence" in our own work could yield powerful results.

Tufte describes fundamental elements of "graphical excellence." These may serve as a checklist in evaluating all manner of data graphics. Attending to these concepts should improve our data graphic outputs, as well as the depth and quality of our understanding of a given issue. Whether data graphic creator, evaluator, or consumer, consider Tufte's points:

Excellence in statistical graphics is present when complex ideas are communicated with clarity, precision and efficiency. Tufte suggests guidelines to consider: Data graphics should display the data, encourage the viewer to think about the data's *substance*, and avoid distorting what the data have to say. Data displays can present many numbers in small spaces while making large data sets coherent. Since they are intended to reveal data at several levels of detail and serve the purpose of describing, exploring and tabulating the data, they should be presented in a manner that will actually allow those goals to be most prominent. Ultimately, says Tufte, "Graphics *reveal* data." (13, *italics* original)

To serve the purpose of displaying data, Tufte puts forth five simple principles for graphical excellence:

- Graphical excellence is the well-designed presentation of interesting data—a matter of substance, of statistics, and of design.
- Graphical excellence consists of complex ideas communicate with clarity, precision, and efficiency.
- Graphical excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space.

- Graphical excellence is nearly always multivariate.
- And graphical excellence requires telling the truth about the data. [14]

There is an ethical aspect to these principles; truth is required as an essential element. Clarity of thought, of evidence, and in presentation is fundamentally important. Transparency is supported; obscuring or manipulating data are ruled out.

These principles are consistent with the critical thinking skills necessary in law enforcement: Information can be a matter of life or death, of safety or injury. Data must be clearly and thoughtfully conveyed to persuade and to influence decision-making. "Good" information, which is reliable, accurate, relevant, is highly valued. Whether formulating tactics to resolve a specific problem, strategies to operate into the future, or policies to best serve the needs of our people, our agencies, and our communities, complex ideas must be communicated "with clarity, precision, and efficiency".

The Future: Law Enforcement Data Dashboards

What tools lie beyond Excel and PowerPoint to show us our own data? Vendors such as Information Builders, New World Systems and The Omega Group now offer their own versions of "Data Dashboards" for the law enforcement markets (15). These are a new type of product for our profession, though familiar for many years in private sector business intelligence tools.

Originally developed for the financial and investment markets, the data dashboard term arises from the metaphor of a vehicle's dashboard, constantly displays real-time critical information to the driver. Instead of a car dashboard's speedometer, odometer,

gauges and warning lights, the data dashboard can display key performance indicators appropriate to the user's needs. These can serve a myriad of purposes, and take many forms, depending on the user's responsibilities and objectives.

A hotel executive may monitor real-time, enterprise-wide information on bookings and occupancy rates; an airline executive may track flight loads, fare revenue, and cancelled flight rates. A police administrator may need to track crime hot-spots and density maps, crime trends, and overtime use. Though dashboards are not locked into one particular design scheme, all present data graphics of one sort or another to inform the user's decision-making processes, and thus may be considered in light of the principles of graphic excellence.

Dashboard data displays are presented in bar and scatter charts, maps, graphs and gauges. Financial websites such as CNBC provide the user with advanced interactive data graphics. Broadcast sports games offer dashboard-like displays: in televised baseball games, the viewer is given a graphic inset showing balls, strikes, outs, inning, base runners, home and away teams and the score; In football, a similar display offers the score, down, quarter, possession, and time outs remaining… all within compact, highly legible, understandable graphics.

Technology consultant and educator Stephen Few is the author of several books on information design and data displays, including one specifically focused on data dashboard design. Few describes dashboards as the "Visual display of the most important information needed to achieve on or more objectives which fits entirely on a single computer screen so it can be monitored at a glance." [16] Sophisticated Dashboards allow the user to "drill down" into the data, interacting with charts to view underlying values

and other data—allowing the user access to more granular data as needed. Displays may allow the user to "slice and dice" the data, e.g. select date and time ranges, or other data specifications, thus allowing the user to refine the area of focus on the particular data of interest.

These products are in their early stages of implementation across law enforcement agencies, and may not be familiar, let alone available, to many in our organizations. Prospective vendors may be able to provide displays to show crime maps, arrest rates, and UCR crime rates. These early stages of product development represent a unique opportunity: law enforcement leaders are in a position to influence their development. What are the most desired elements of a data dashboard display? The answers vary, depending on the agency, the roles and responsibilities of the user, and the user's available data accessed from the dashboard. Robust dashboard products should be configurable to meet a variety of needs, and the data graphics display designed to convey data in easily understood design schemes.

This early point in the product development cycle can allow Law Enforcement customers key strategic opportunities: By becoming informed consumers of data graphics, law enforcement customers can exert influence and firm direction on data dashboard developers. Sensitive to the potential for increasing product quality, sales and market share, vendors routinely seek client input and feedback to improve their product. Here, then, is an opportunity for visionary leaders to demand graphical excellence of these new technologies and products.

Is a simple display of one or two pieces of data worth the substantial investment of time, money, and staff resources needed to implement a data dashboard? Rather, law

enforcement executives can insist on sophistication in data graphics. Scrutinize carefully vendors' products. Use opportunities to collaborate with and guide vendors. Do the displays show multivariate data? Are the designs accurate and illustrative, or do they inadvertently distort the data? Can the user drill down, and cut and slice the data? Are map animations possible? These lines of questioning are limited only by the profession's collective imagination, and all benefit from a tenacious insistence on the highest possible data graphic quality products from vendors. Bringing sophistication to our evaluation, feedback, and acceptance of analysis and display products will help vendors provide sophisticated products in return.

Conclusion

Just as Law Enforcement customers attuned to the value of superior data graphics can insist upon investing only in well-crafted data displays, they must also consider their role in the creation of the data sets from which dashboards draw their information. An agency must ensure its data gathering and records management systems are properly implemented. Complete, highly accurate data must be properly gathered, reviewed, and stored before a data dashboard can be utilized. [17] Astute awareness of the importance of data graphics, insistence upon quality products from vendors, and the use of high quality data will ensure law enforcement professionals are gaining the greatest value from their investment in future technologies.

Endnotes

[1] NASA Mission Control announcer, live broadcast of STS-51L Space Shuttle Challenger Launch, January 28, 1986, Cable News Network, Turner Broadcasting

System, Inc., Atlanta, GA, http://www.youtube.com/watch?v=AfnvFnzs91s (accessed March 18, 2013)

[2] John Snow, MD, On the Mode of Communication of Cholera, 2nd edition, London, 1855, http://www.ph.ucla.edu/epi/snow/snowbook2. (accessed March 18, 2013)

[3] Robert E. Horn, Information Design: Emergence of a New Profession, Information Design, The MIT Press, Cambridge, Massachusetts, 1999, p.15

[4] Robert Jacobson, Introduction: Why Information Design Matters, Information Design, The MIT Press, Cambridge, Massachusetts, 1999, p. 4

[5] Romedi Passini, Informaiton Design: An Old Hag in Fashionable Clothes? Information Design, The MIT Press, Cambridge, Massachusetts, 1999,p. 84

[6] 2012 Looseleaf Law Publications catalog "Essential Resources for Today's Professionals": Not one of over one hundred law enforcement publications addresses graphic or information design as a law enforcement resource, tool, or skill. Broad internet searches return alarmingly meager results: A Google search for "information design" with "crime analysis" returns a mere fifteen hits; a search for "information design" with "law enforcement" returns 342. (accessed March 18, 2013). Literature on information design in law enforcement appears to be non-existent.

[7] Edward Tufte, Visual Explanations, Graphics Press, Cheshire, Connecticut, 1997, p. 40,

[8] On the Mode of Communication of Cholera, 2nd edition, London, 1855, http://www.ph.ucla.edu/epi/snow/snowbook2. (accessed March 18, 2013)

[9] Edward Tufte, Visual Explanations, Graphics Press, Cheshire, Connecticut, 1997, p. 45

[10] Daniel Cressey, Modelling Feynman, Nature Magazine, MacMillan Publishers Limited, Volume 489, 13 September 2012, p. 207

[11] Edward Tufte, Visual Explanations, Graphics Press, Cheshire, Connecticut, 1997, p. 45

[12] Edward Tufte, The Visual Display of Quantitative Information, Graphics Press, Cheshire, Connecticut, 1983, p. 191

[13] Edward Tufte, Visual Display of Quantitative Information, Graphics Press, Cheshire, Connecticut, 1983, p. 1;

[14] Tufte, Visual Display of Quantitative Information, 1983, p. 51

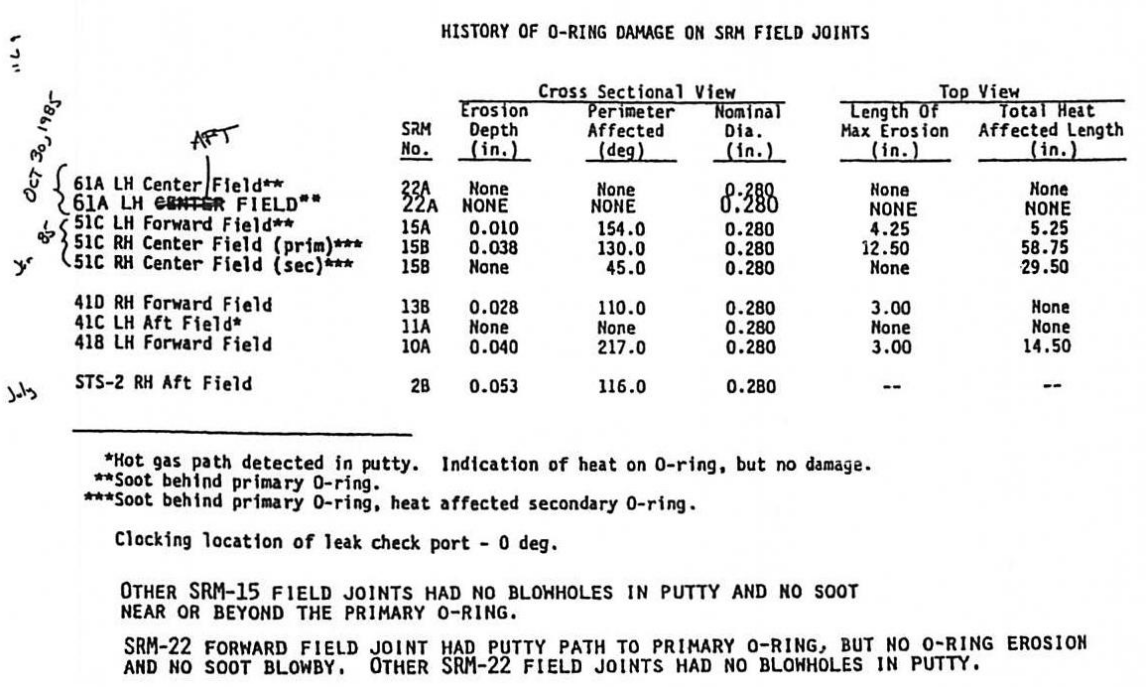
[15] E.g.: Information Builder's "Law Enforcement Analytics" http://www.informationbuilders.com/pdf/factsheets/FS_Solution_WFiWay_LEA_2012.pdf (accessed March 19, 2013); New World Systems' "Aegis Decision Support" http://www.newworldsystems.com/Public_Safety/Solutions/Law_Enforcement/Decision_Support/index.asp (accessed March 19, 2013), and The Omega Group's "CrimeView Dashboard" http://www.theomegagroup.com/police/omega_dashboard_police.html (accessed March 19, 2013)

[16] Stephen Few, Information Dashboard Design, O'Reilly Media Inc., Sebastopol, CA, p. 34

[17] Bruce Silva, The Importance of Having Great Crime Data, Omega Group blog entry, http://info.theomegagroup.com/blog/bid/133239/The-Importance-of-Having-Great-Crime-Data (accessed March 19, 2013)

Illustrations

Figure 1: Challenger Data, partial image, from Visual Explanations, p. 41:



HISTORY OF O-RING DAMAGE ON SRM FIELD JOINTS

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*Hot gas path detected in putty. Indication of heat on O-ring, but no damage.
**Soot behind primary O-ring.
***Soot behind primary O-ring, heat affected secondary O-ring.

Clocking location of leak check port - 0 deg.

OTHER SRM-15 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY AND NO SOOT NEAR OR BEYOND THE PRIMARY O-RING.

SRM-22 FORWARD FIELD JOINT HAD PUTTY PATH TO PRIMARY O-RING, BUT NO O-RING EROSION AND NO SOOT BLOWBY. OTHER SRM-22 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY.

Figure 2: Snow's Map (detail) http://www.udel.edu/johnmack/frec682/cholera/snow_map.png

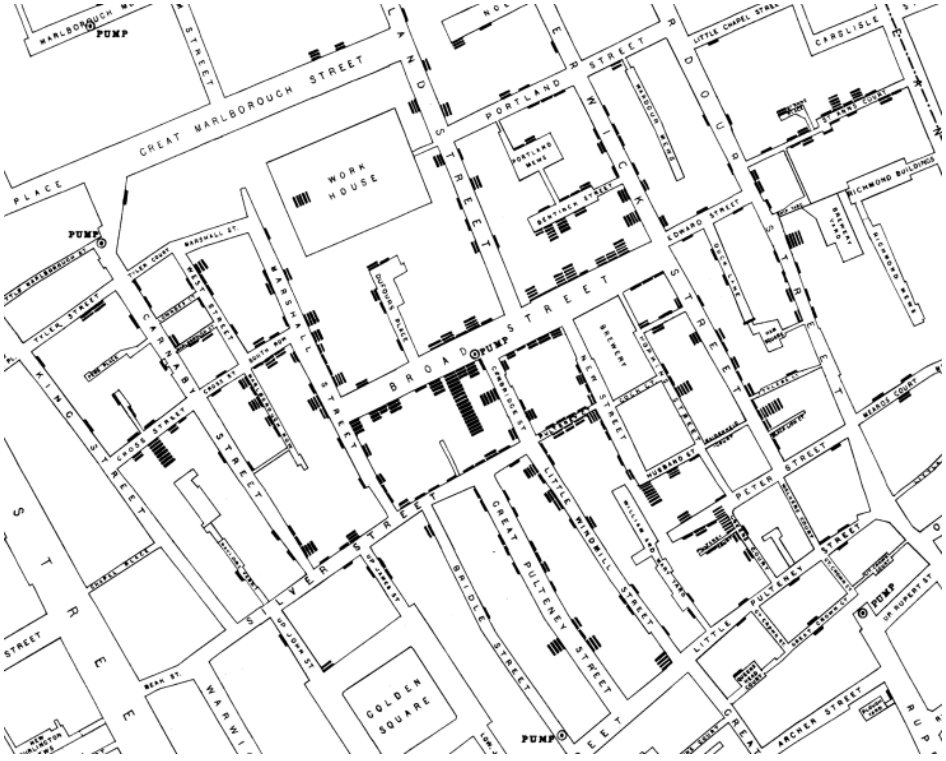

Figure 3: Tufte's Challenger Data Graphic, showing damage vs temperature, Visual Explanations, p. 45