Dynamic Design Documents for supporting applied visualization

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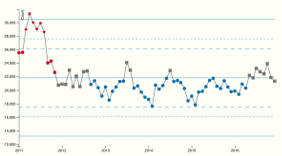
Applied Visualization requires close collaboration between visualization researcher and domain expert — especially so where new techniques are introduced that disrupt existing workflow. For fostering such close collaboration, we developed dynamic design documents (DDDs): highly interactive, data rich web-based reports detailing our re-designs, where analysts can explore, learn, test and evaluate design configurations for themselves — in their own time and within an analysis context that is real and familiar.

DDDs published at: `https://rooch84.github.io/spc/`

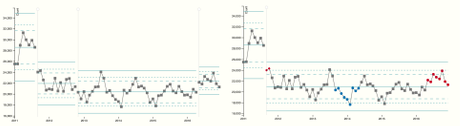
Fostering critique of existing process

Our DDDs encouraged the small team of crime analysts with which we collaborated to problematise existing design and workflow.

Statistical Process Control chart monitoring (SPC) is an established technique used by crime analysts. Analysts were first presented with a single SPC chart and encouraged to explore signals and processes that might be inferred. As a consequence, analysts reflected on the uncertainty and variability associated with SPC signatures (signals and processes). They also began to identify follow-up questions — most often whether observed patterns are consistent across crime type and location.



A standard SPC chart. This chart shows all crimes committed in the West Midlands, aggregated by month. Select individual data points to treat them as outliers and remove them from the analysis. Create process markers by clicking on the graph. Click this button to toggle automatic process detection.

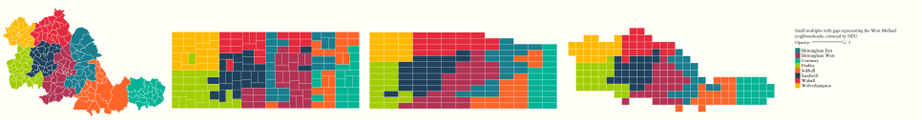


Default breaks - automatic User-defined breaks

Introducing new layouts and visual grammar

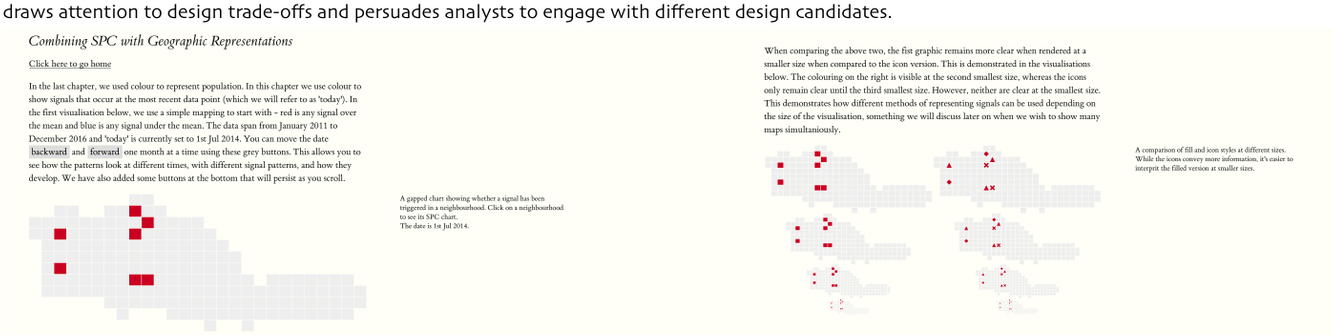
By exploring our re-designs independently using DDDs, crime analysts learned the new data mappings, formed a view on them and developed a sensitivity to the trade-offs involved in designing for greater data density.

Analysts were introduced to various semi-spatial orderings onto which composite views of SPC signals and processes are eventually overloaded. To reinforce learning, analysts interacted with and explored this ordering for themselves.



Design process as ordered narrative

Our DDDs present design iterations that follow a very deliberate order: starting with highly abstract views displaying only the most important information, we gradually introduce detail and eventually discuss data-rich, visually complex, graphic composites. Ordering documents in this way draws attention to design trade-offs and persuades analysts to engage with different design candidates.



Combining SPC with Geographic Representations

Click here to go home

In the last chapter, we used colour to represent population. In this chapter we use colour to show signals that occur at the most recent data point (which we will refer to as 'today'). In the first visualisation below, we use a simple mapping to start with – red is any signal over the mean and blue is any signal under the mean. The data span from January 2011 to December 2016 and 'today' is currently set to 1st Jul 2014. You can move the date backward and forward one month at a time using these grey buttons. This allows you to see how the patterns look at different times, with different signal patterns, and how they develop. We have also added some buttons at the bottom that will persist as you scroll.

A gapped chart showing whether a signal has been triggered in a neighbourhood. Click on a neighbourhood to see its SPC chart.
The date is 1st Jul 2014.

When comparing the above two, the fist graphic remains more clear when rendered at a smaller size when compared to the icon version. This is demonstrated in the visualisations below. The colouring on the right is visible at the second smallest size, whereas the icons only remain clear until the third smallest size. However, neither are clear at the smallest size. This demonstrates how different methods of representing signals can be used depending on the size of the visualisation, something we will discuss later on when we wish to show many maps simultaniously.

A comparison of fill and icon styles at different sizes. While the icons convery more information, it's easier to interprit the filled version at smaller sizes.

Testing designs within their intended context of use

As is typically the case in applied visualization, we develop a set of re-designs that are data dense through careful manipulation and combination of visual variables. Through our DDDs analysts were able to inspect these layered graphics for themselves — from their own machines, in their own time.

A gapped chart showing both signal and process information for each neighbourhood, as well as a mark showing the mean of either the last data point or the signal. The icons are coloured white. Click on a neighbourhood to see its SPC chart.
The date is 1st Jul 2014.

Multiple charts, each representing crime type. Signals are represented by fill colour. Click on a neighbourhood to see its SPC chart.
The date is 1st Jul 2014.
Opacity: 0.11

Effect on applied visualization

Our DDDs help collectively identify a rationale for re-design, introduce analysts to the various trade-offs associated with re-design, in their words "demonstrating the thinking process" (Operational Analyst), and help persuade them of a new visual grammar that might initially "tend to overwhelm" (Strategic Analyst). By physically distancing visualization researcher and domain expert, they engender a level of critical engagement qualitatively distinct from earlier studies in which we have engaged. Reflecting on our recent experience, we speculate that DDDs might help partially overcome more intractable problems to evaluation in applied visualization: most obviously that of social-desirability bias, where collaborators give responses to key questions that they think we would want to hear.

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