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How to Successfully Build and Adopt Analytical Dashboards to Support Decision Making

An Evidence Based Approach

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About the Author of this Document

The author Mikko Kotila has been working with analytics and data for the past 20 years, and is a respected thought leader with a proven track record in groundbreaking industry innovation. An advisor to the World Federation of Advertisers, Co-Chair of the I-COM Data Science Board and an investor and board member to many data and technology companies, Mikko is a popular speaker and an author on the topics of data and analytics.

- As a vendor serviced over 100 Fortune500 companies and many global agency networks in analytics, dashboards and insight projects
- Actively used web and other analytics solutions since 1996
- Designed and led building of the first media planning solution for the programmatic media industry
- Designed and led building of multiple global firsts in serious social media insight and analytics
- Arguably started a new era in web analytics by introducing many novel features, now found in the standard web analytics industry feature-set
- Designed and led building of behavioural targeting based content personalisation system
- Designed and led building of multiple very high volume (>10,000 instances per second) data management platforms

"Mikko embodies the expression "'thinking outside of the box'". He's generally familiar with using new technologies and approaches in marketing when others are just hearing of them for the first time." - Barry Adams, General Manager at Experian

"Mikko is a fabulous thinker, leader, and visionary. He knows how to think big and how to execute in a way that brings results" - Traci Fenton, CEO at WorldBlu

"Mikko has the ability to take some thing from a brainstorming session and have it in prototype in a matter of days. It is truly amazing. I expect to be working on things with Mikko for many years to come." - Matt Harty, General Manager at Accuen

Important Points on Dashboard Projects

In the 20 years I've worked with analytics dashboards, as a user and as technology developer, I've learn that most projects never end up satisfying the end-users. Disconnection between the product team and the users, lack of understanding of basic fundamentals of displaying data and poorly planned projects are the three key factors leading to failure.

Arguably the main cause for failure in dashboard projects is the belief that a longer-term solution can be created in the initial project. This is never the case, nor is it possible to achieve a good long-term results in the short-term.

Building an organisational dashboard is an iterative process, where the initial goal is to understand the fundamental needs and processes of the organisation and then create a minimum viable product to support that particular situation. A thorough discovery is essential for success.

Once moving to the design and build phases, the goal of the initial solution is not to fulfil all the needs of all the users for years to come. Instead, the purpose of the initial platform is to act as a base for future development.

After the initial phase, where assumptions about the organisations objectives and the user's ability drive the development, further development should be based on analytics data and survey responses that explain user behaviour and success factors pertaining existing use-cases.

A typical dashboard is expected to be used by individuals who often have no previous experience in working with such solutions nor are savvy with analytic data. Therefore it is essential to incorporate systemic behaviour change thinking in to the system as opposed to just showing numbers.

Users unfamiliar with dashboard solutions, require to have the insight and the instructions on how to use that insight displayed together. Actually an insight is something that can be acted up in practical terms, which means the user must know what to do with the data they are exposed to.

Further to considering just less savvy users, it is important to avoid including vanity metrics in the system. Instead all data should be actionable and displayed in a that makes it clear for the user what they can do with it. It is therefore important to stray away from so-called “vanity metrics” that while nice to know, have little actionable value. At the same time, it is important to understand that not all vanity metrics are created equal.

Sometimes a metric that seems a vanity metric, is not necessarily so. For example in the advertising world, an ad impression is widely used as a standard campaign measurement, even though it only indicates how much money has been spent and not at all how well the money was spent.

Impression and reach are standard metrics for advertising measurement. One could argue the vanity of both, yet trillions of dollars of advertising has been done just with these two, so in that sense there is no vanity at all in those metrics. Due to this, a media dashboard would have to put significant focus on the impression metric.

Evidence Based Dashboard Design

To ensure both short-term and long-term success for an investment made in to analytics dashboard capabilities, before anything else, one must follow a 6-step process to establish the fundamentals of the case:

1. Identify the common beliefs related to the problem

(e.g. marketers make important decisions without evidence, often leading to poor campaign outcomes)

2. Identify the common beliefs related to the solution

(e.g. if the marketers had access to the right data, they could make better decisions leading to better outcomes)

3. Identify the values (data) that are suspected to have causal relationship with outcomes

(e.g. how investment in to different channels have historically affected sales of the advertiser's products)

4. Identify possibilities / limitations related to the identified values

(e.g. sales data is only available monthly, where as spend data is available more frequently)

5. Identify ways ways to make data more telling or useful

(e.g. use “boot strapping” or other technique to get away with small sample size with the sales data).

Once these fundamentals are established, a simple document can be created to test this established understanding against real business cases and with real users to get initial feedback.

Following a method less rigorous than the one described above is likely to lead to inferior results both in the short-term and long.

This way also significant resources are saved, as nothing is built without thorough research, planning and validation. Once the initial build is up, it is far harder to get rid of unnecessary values and there is also less room for new, potentially useful, values.

11 Questions to Ask About the Use of the System

There are 8 fundamental questions that lead to the minimum required insight about the the use of the planned system:

1. Who is going to use it?
2. How often they are going to use it?
3. In what physical situation are they going to use it?
4. What is their ability to describe the problem to the device?
5. What are they expecting to get in return for their input?
6. How are they planning to use the output in case they have it?
7. How does success look like when they are able to get it and use it?
8. What happens if they are not able to get it or use it?

In addition to the above questions, there are many complimentary questions, of which there are 3 recommended:

9. What metrics are already used in the organisation / by the users to measure success?
10. What other metrics are already used in the organisation / by the users?
11. Are there other data / information they would like to include in the dashboard?

The 18 Aspects of an Analytics Dashboard

There are all together 4 internal factors (those that can't be seen by the user):

1. data collection
2. data storage / backup
3. data processing
4. data availability

In addition there are in total 13 external factors (those that can be seen by the user):

- | | |
|----------------------------------|---------------------|
| 1. top-line values | 8. reward systems |
| 2. index values | 9. settings |
| 3. segmenting features | 10. tooltips |
| 4. comparison features | 11. tutorials |
| 5. pre-determined visualisations | 12. recommendations |
| 6. custom reporting | 13. goals tracking |
| 7. alert features | |

These 18 aspects combined represents the entirety of the factors that go in to designing and building, and eventually using an analytics dashboard.

Important Points on User Behaviour

To continue from the point of the previous section, a cluttered dashboard leads to a clutter mind (of the user). While it is not possible to design a user experience, it is possible to design for a user experience. Designing for user experience, in other words maximising likelihood of success, is based on establishing a strong understanding of the user.

Every single time the user engages with the dashboard, he or she follows a simple 4 step cognitive process:

1. Triggers remind the user that they should do something
2. Motivation allows them to start doing it
3. Ability allows them to successfully do it
4. Available cognitive energy & time decide how well and long they will do it

Finally, did the user act upon the data, and what was the business result that came out of the action, is the most important point. This is where the great majority of dashboards fall short, and is arguably the holy grail of analytic dashboards.

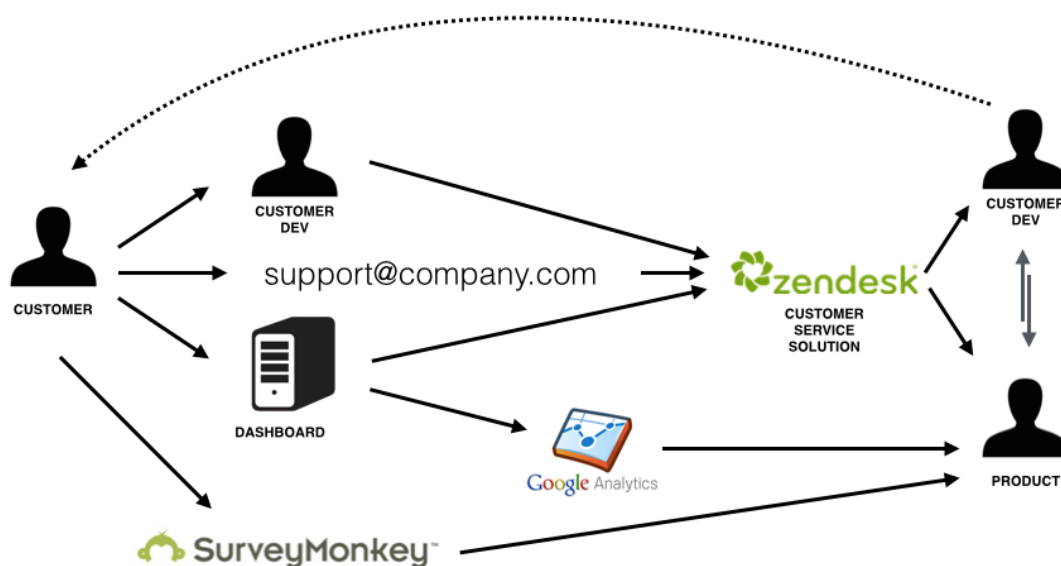
While there is a tendency to add things instead of removing, this urge must be resisted. The users cognition (and time) is limited, and it essential to appreciate this fact by providing the user with only what is essential to answer their need and make their use of the system worthwhile and rewarding.

Metrics that are already used by the users are particularly problematic from the behavioural standpoint. First because it is familiar, it is assumed that it's valuable. Then with the false assumption of value, the cognition anchors in to these often inferior values. Many bad data-driven decisions are caused by ignoring this single point alone.

7 Ways of Collecting Data About the Use of the System

1. sensors (from the device)
2. device usage metrics
3. content (values) usage metrics
4. individual session metrics
5. survey questions
6. user support interactions
7. business team interactions

To manage all the incoming data about the use of the system and the needs of the users, it is important to establish a formal system called "feedback loop". This is one of the key factors that can be found in most if not all successful dashboard projects. The below graphic illustrates a flow of information coming to the product and business teams, and then going back to the user as it's handled.



On the Importance of Showing the Right Values

The basic principle is that every value that goes in to the dashboard, is properly validated before being decided upon.

A dashboard will typically be used anywhere from 5 to 20 years, depending on the use case, organisation and the magnitude of the investment made. Some of the numbers that get included early on, end up burdening the system and its users for the entirety of its lifetime.

The 5 principal questions that must be asked are:

1. Is there an established causal relationship between the value and outcomes?
2. Is there other primary or secondary research that supports including the value?
3. Is it the best value to speak for what we want it to speak for?
4. Does it have the potential of leading the user to action?
5. Is it easily understandable by an average user of the system?

Choosing the Right Data to be Displayed In Analytics Dashboards

Before adding something to a dashboard the data source and the output values have to be tested for at least four things:

1. validity (is it accurate)
2. stability (is it as accurate every time)
3. usefulness (will the user take action on it)
4. longevity (will it be available for the long-term)

The fact that the proposed numbers have been specifically requested by user/s, does not change this. This is due to three primary reasons:

1. users only know what they already know
2. users are rarely experts in dashboard design and analytics
3. users often have poor understanding of the causality between data and outcomes

It is also not a good reason to keep something in the dashboard just because it is already used by users. The users would often rather keep on doing what they already know how to do. Even if they knew that it would lead to inferior outcomes.

11 Points on Displaying Data in Analytics Dashboards

1. Always use thousand separators
2. Lock in the display order of graphs (see attached image)
3. Always include labels for graphs in a visible place
4. Use clear labels for all tables, and tooltips when needed
5. Always use thousand separators
6. Consider if you need decimals, and if you need, how many
7. Use appropriate markings always with values (% , \$, etc)
8. Only use proper english and avoid jargon
9. Choose graphs based on use (e.g. pies are good for max 3 data points)
10. Lock in the display order of graphs (see attached image)
11. Always include labels for graphs in a visible place

Often it's a good idea to provide summaries where numbers are combined with conclusive statements generated by the system. These kinds of

summaries are best displayed upon user's login, so they can quickly establish an understanding of possible issues and trends to watch out for and at the very least, establish a view of what has changed since they logged in last.

27 Points Generally on Design

It is relatively common for the visual designer of the project to be somewhat disconnected from the practice of analytics and data science. For which reason, separate guidelines are needed for the graphic design aspect of dashboards.

Successful design always starts with research. There are 5 preliminary points:

1. Establish clear understanding of the user of the system
2. Establish clear understanding of the use cases
3. Establish clearly what is the objective of the project
4. Establish project timelines clearly and definitely
5. Summarise in writing your understanding of the user, use cases, project objectives and timelines

Once these steps are successfully concluded, the designer must confirm the summary with the project lead in writing. The designer can not proceed unless the mutual understanding with the project lead have been established in this way.

Further there are 15 additional guidelines:

6. Establish an invisible grid as the base for the design
7. Always place objects on the grid neatly
8. Use empty space generously

9. Avoid strong contrast
10. Avoid weak contrast
11. Never use dark backgrounds
12. Avoid using gradients
13. Only use clean and crisp high quality images
14. Maintain a unified look across the entire platform
15. No more than 3 different type faces
16. It's better to design for a user than it is for a client
17. It's better to design for a particular task than it is for a user
18. Minimise number of clicks to perform each task
19. Show only what is useful
20. Hide things in ways that are obvious for the user
21. Always backup working files at least every 30 minutes

It is well known that most things fail closer to the end. Therefore it is very important to be meticulous when finishing design.

6 Tips for the Amazing Finish and that WOW:

22. Fine lines help with finished look
23. Good artist copy, great artist STEAL
24. Great design looks expensive
25. Zoom in and focus on the smallest detail
26. Good design always looks "expensive"
27. 99% of the wow comes from the last 1% of work

The Role of Theory in Analytics

Many quantitative analysts have little regards to theory. The common approach is that if the numbers say something, then it must be so. There could not be an attitude more dangerous for the organisation when it comes to data.

Use of data for decision making is called data science and data science is a field of science with its success (or failure) deeply rooted in the application of the scientific method.

If there is no clear understanding of theory, then it is not possible to establish a meaningful hypothesis. If there is no meaningful hypothesis to test, then there is no role for data.

When choosing the right values to be included in a dashboard, it is very important to base those decisions on a deep understanding of the conditions those numbers are expected to correlate with. Next, it is equally important to diligently follow the scientific method to establish and test a hypothesis which is founded on the theory.

A landmark book "How to Lie with Statistics", written in 1950's, gave interested audiences a view in to how numbers can be used and are actively used for making false assumptions about the underlying conditions. When there is strong theory, a deliberate hypothesis and then values that support it, it is far harder to use numbers for deceit or to be confused by them.

Commentary on Samples

While typically in dashboard projects sample sizes are not an issue and frequently sampled data is widely available, it is important to understand the fundamentals of sampling and how it relates to the reliability and ultimately the quality of the decisions made based on the data.

There are 5 key points to consider:

1. Is the sample large enough (N=40 per cell)
2. Does the sample violate "independent sampling" principle
3. Does the sample represent the user group it is supposed to
4. How was the sample produced (manual coding, user input, etc)
5. Can the source of the sample be trusted

On Confidence and P-Values

When we talk about data science, it's important to make the distinction of what confidence means. When p-values are used to indicate confidence, the user must understand the difference between:

"this test result has a 99.99% confidence"

and

"this will happen 99.99% of the time in the real world".

The key principle is that by looking at just the p-value, we can't assume that to be a prediction of anything more than the test itself.

In data science everything is just a hypothesis, and a test result is just a test result against the hypothesis. p-value of <0.01 says "this test conducted against that hypothesis yielded a result that is very unlikely to be by chance". It says nothing about the validity of the hypothesis. This is very important to understand.

In a typical situation you have to worry about market factors, behavioural factors, data quality, sampling violations, source bias, vendor bias, human error and a plethora of other aspects.

With the combination of theory, qualitative findings and quantitative data one can establish confidence in test results. When they all seem to tell the same story, there is substantial confidence. When one of it says something else, there no longer is any confidence at all.

It is also important to understand that the goal is rarely to have 99.99% prediction capabilities. Instead it is to provide meaningful aids that lead to the users reaching their goals with greater confidence. In most cases it is true and valid that "it's better to be roughly right than precisely wrong" as the famous economist Keynes is known to have said.

The confidence is never in the test results. The confidence is in our own understanding of the markets, brands and consumers and the interplay of all that with the data and results. And in the way tests conducted over an extended period of time reflect on our understanding.

6 Types of Cost from Analytics Dashboards

Typically dashboard investments are initially focused on the build cost, to later find out that it only represents a part, often minor, of the total investment. There are 6 types of cost to be considered:

1. Initial build
2. Cost of ownership
3. Cost of data acquisition
4. Cost of training
5. Cost of use
6. Other costs

Initial build cost often represents a small fraction of the total cost of ownership (TCO). This is true especially to systems where the backend is poorly designed and in systems that have heavy data visualisation requirements for large datasets. Actually it is hard to justify heavy availability requirements unless there is a significant number of people using the system.

Cost of data acquisition is relevant to systems that use external data to produce all or part of the values. It is a popular data industry trend that a given source is first free, and later becomes paid resource. So even if at the moment of the design a particular external data source is available for free, a lifetime cost should be still calculated for it.

Cost of training and the cost of having people use the system are typically the largest single cost for the organisation. The poorer the initial design and the build of the system, the greater the cost of training and use becomes for the organisation.

Ironically the worse the system, the more likely the entire project will eventually be abandoned, thus resulting in nothing but cost. As a point of reference, a great majority of the initial enterprise CRM projects failed and were later replaced with entirely different solutions. Many of these projects costed millions and tens of millions to the organisations in question.

A key learning from these failed projects was that unless the solution supports the organisations way of operating, it will be very hard to make it part of the way it does business. This point leads us to the emphasis on custom built dashboards over choosing an off-the-shelf one.

Other costs are costs that don't fall in to the other categories of cost, and should always be included in the lifetime cost as an additional 10-20% item. This number should depend on how experienced the build team is and the organisation's past experiences in successfully adapting similar solutions.

It is also worth noting that education is a generally a key aspect and often a natural by-product of introducing a new dashboard to the organisation. Basically helping the users understand the various data points and how they relate to business outcomes.

In the 21st century, few things get people excited like a nice brand-new dashboard. Therefore it is a great platform for introducing new behaviours. Behaviours that lead to the essence of every successful dashboard project, cultural change.

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