

## Creating the Perfect BI Report: Where to Begin

Lisa Eckler, Lisa Eckler Consulting Inc., Toronto, ON

### ABSTRACT

We've learned a great deal about how to develop great reports and about business intelligence (BI) tools and how to use them to create reports, but have we figured out how to create true BI reports? Not every report that comes out of a BI tool provides business intelligence! In pursuit of the perfect BI report, this paper explores how we can combine the best of lessons learned about developing and running traditional reports and about applying business analytics in order to create true BI reports that deliver integrated analytics and intelligence.

### INTRODUCTION

Many industries are facing disruptive changes. To make these disruptions a positive experience, we need to be prepared for innovation; ready and able to act on business intelligence. At the same time, we may be in competitive industries where we have similar products, compete for the same customers and face the same external constraints and regulatory requirements as our competitors. We need to harness the value of our data and make acting on that value easier. One of the ways to do this is by providing real business intelligence to the decision-makers.

We will see that perfection is very specific and subjective. So, of course there is not a generic way to deliver **the perfect report**. We can, however, work toward delivering **a perfect report** for a particular set of needs. The approach described here for a perfect report will help us to address the needs of a recipient who is a decision-maker with excellent reports for particular situations or circumstances. We can – and should – aspire to perfection even though we probably don't have all the tools necessary to deliver it yet.

### BACKGROUND

#### DEFINING TERMS

Many of the terms that apply here are so commonly used elsewhere, sometimes interchangeably, that the nuances get lost. For the sake of this discussion:

**Data** is the most granular of facts, stored in machine-readable form.

**Information** is a consolidation and organization of data into meaningful structures, giving some context to the data.

**Knowledge** is the process of understanding information and gleaning insight from it. Knowledge that can be applied to form the basis for informed action is very specific to the situation and environment.

**Wisdom** is knowledge plus the experience or judgement needed to make use of it.

**Big Data** is data that is high in volume, growing and changing rapidly, and highly variable and complex in structure. The volume and frequency of its arrival may be unpredictable.

## Intelligence

from [www.dictionary.com](http://www.dictionary.com)

### INTELLIGENCE

noun

1. capacity for learning, reasoning, understanding, and similar forms of mental activity; aptitude in grasping truths, relationships, facts, meanings, etc.
- ...
3. the faculty of understanding.
4. knowledge of an event, circumstance, etc., received or imparted; news; information.
5. the gathering or distribution of information, especially secret information
- ...
7. interchange of information.

## Perfect

from [www.dictionary.com](http://www.dictionary.com)

### PERFECT

adjective

1. conforming absolutely to the description or of an ideal type.
2. excellent or complete beyond practical or theoretical improvement.
3. exactly fitting the need in a certain situation or for a certain purpose.
4. entirely without any flaws, defects, or shortcomings.
5. accurate, exact, or correct in every detail.
6. thorough; complete; utter.
- ...

## HOW DO WE GET VALUE FROM DATA?

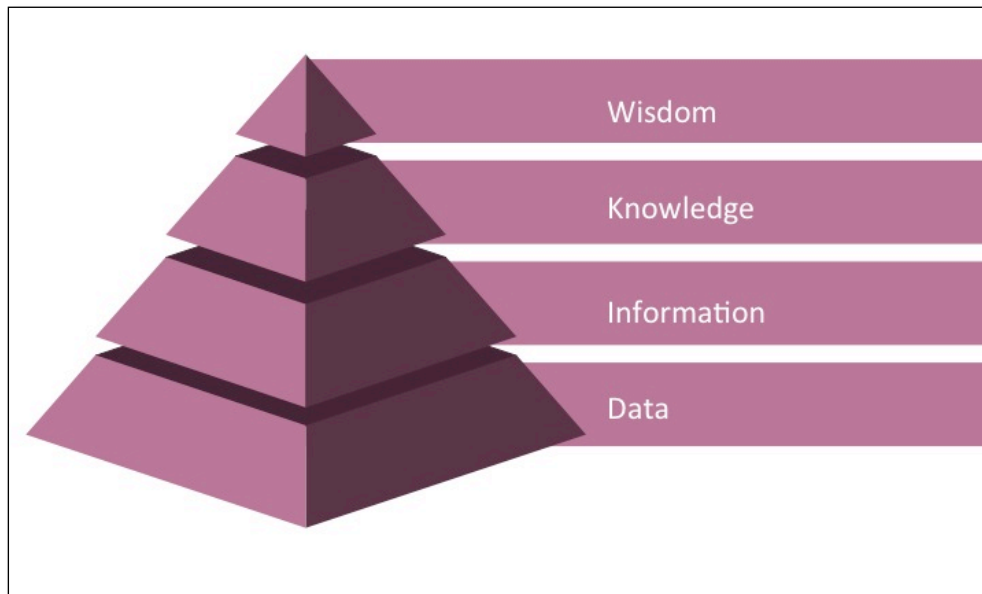


Figure 1: The Data-Information-Knowledge-Wisdom Hierarchy.

Figure 1 illustrates the Data-Information-Knowledge-Wisdom (DIKW) Hierarchy, which is also known as the DIKW Pyramid. It's a representation of information architecture that we can apply to reporting. Business value increases as we move up in the hierarchy.

Most large organizations have accumulated lots of data, with impressive amounts of new data arriving by the day. Over a relatively short period of time we've become adept at gathering, manipulating and storing data. We learned that there's power in transforming data into information, which is more meaningful and useful in business, and so shifted our attention to delivering information. Instead of drowning in data, our users now face information overload. What's needed is not more or faster delivery of information but knowledge – especially knowledge that decision-makers can act on.

## WHAT IS BUSINESS INTELLIGENCE?

There is no consensus as to the definition of BI. It has become common to speak of BI in reference to the tools used to implement a process for managing and delivering data to users. BI tool is the term used to describe a class of software products that provide rapid, high-volume data search and summarization to end-users through a friendly interface. There are several such BI tools commercially available. They put the emphasis on the technology that delivers data to business users in a reasonably digestible form, often graphically. Some of those tools are even called BI Reporting Tools and are intended to let non-technical users create and customize their own reports. What these tools deliver is typically historical data that has been summarized. That's information, but not particularly intelligence, so it's a stretch to call it BI reporting. Getting more information into the hands of non-technical users, and getting it there faster, is worthwhile but it's not the same as delivering true business intelligence. BI is not a product or technology.

**BI is the applied practice that combines the strategies, data, applications and technology needed to transform business information (built from business data) into actionable knowledge** and delivers that knowledge where it's needed. That's how we can best support decision-makers. Making data useful for BI means surfacing knowledge, not data. Surfacing data or information is much more common, because it's easier, but we should aspire to deliver what's most valuable. Until then, we are delivering information – maybe even too much information – and expecting our decision-makers to turn it into knowledge themselves.

## Measurement ≠ Intelligence

Measurement gives us data. Most business organizations have figured out how to convert their data into information in a manageable format, which is a requirement for business reporting. Data is a raw material that can be transformed into knowledge but it is not, by itself, knowledge. It may be that **only what gets measured gets managed**, but measurement is only one essential input to management. The first challenge of BI reporting is to transform business information into knowledge and the next is make the knowledge served up in our reports actionable. We'll look at ways to do that in the section below labeled "How do we apply everything we've learned to perfect BI reporting?".

BI tools are known for quick processing and delivery of massive amounts of data. Most often, the data that is fed to those tools is measurement of what has occurred (sales activity, production results, text from customer feedback, etc.) so what we're getting is rapid search and summarization of measurements (or even sentiments) which are retrospective. Historical facts are not the same as insight or intelligence. It is worth knowing what has happened in the past and trying to understand why, but that alone doesn't tell us what action to take.

### WHAT IS A REPORT?

In automated information delivery, what we refer to as a report is quite different from a report that comes from outside of information technology (IT). Beyond IT, a report usually refers a singular document that is the product of information gathering and critical analysis and presents recommendations to decision-makers and other interested parties. The emphasis is on the analysis done by the preparer(s). The expertise and reputation of the preparer(s) – or author(s) – is significant. Such reports will often be the basis of discussion and ultimately decisions, but these tend to be one-time occurrences where each report attracts lots of debate. In contrast, what we call a report in IT, which will be called a business report for the sake of discussion here, is the periodic preparation and delivery of select data that has been formatted in a way that's convenient and meaningful for the recipient.

The earliest of form of computer-generated report in business was a simple list that displayed a collection of data. These reports allowed businesses to grow in size and complexity beyond what could be reasonably tracked and managed through manual record-keeping. There was a time when being able to sort and summarize data into printed lists was enough to provide a competitive advantage. These lists or summaries of current details were a huge operational support. That seems like a very long time ago. We soon achieved the benefits of gathering and storing more data, creating multiple levels of summarization and different views of summarized current and historical data. Along the way, we added calculations to our reporting programs, improved the programs and processes to execute our programs, made the results look more appealing, and delivered them in a variety of formats and to a variety of devices. These business reports document the measurement of what has occurred and deliver it in a convenient way. The emphasis has been on ways to create the same or similar content with improved efficiency or better formatting or delivery. Sometimes we choose to sacrifice flexibility and control over appearance in the interest of delivering more, faster.

Report used to mean a printed document, then delivery of an electronic document, then delivery of structured presentation of data that is that is explorable (like a pivot table in Excel) and eventually dynamic data delivery in a BI tool. The casual definition of report has evolved even further now that our business users can use a BI tool and get their own answer, customized their own way. Self-service is very helpful for data discovery exercises and the data transparency helps build credibility, but there is even more need for carefully-considered reports that are consistent, contextual, fully validated, thoroughly documented and reproducible.

Most computer-based business reports are retrospective, with most of the effort invested in manipulating and formatting measurement data to offer a snapshot of where we are at a particular point in time and maybe including a series of trending numbers. At best, they project a future trend based on the same trajectory.

## WHAT MAKES A REPORT A BI REPORT?

Most of our current business reporting is **results reporting**. It tells us what we have done. Sometimes these results are compared to our budget or plan (what we expected to do) but that still doesn't tell us what we might have done or what else we can do, or how we can solve the problem if we failed to achieve what we planned.

What about considering what we can do as opposed to what have we done? Although what is commonly called a BI report is an organized collection of facts, a true business intelligence report is a roadmap for success. How can we use the facts – and inferences from them – to improve our outcomes? Outcome here is whatever business result the user is mandated to achieve (sales, performance, cost control, production, quality, etc.). Knowing what we achieved in a particular period (day, week, month, quarter or year) and how that compares to a previous period, or to our target, or even to a peer's or competitor's results is only one component of achieving the best possible outcome. After looking at our measurements, the next logical question is how to improve on them in the future. Obstacles and limitations are often difficult to quantify or categorize along with our results. How about recommendations on ways to improve? Here's where we have lots of opportunity for innovation.

BI reporting is not a replacement for all business reporting. Regulatory reporting needs fixed data inclusions, fixed time (whether periodic or single time point) and structure. This is a limited but very important need for a standardized set of information in a pre-defined format – with no room for error. For these requirements, the measured facts – and only the facts requested – nothing more and nothing less, is appropriate. This is a case where additional insight or creativity would not be appreciated. The perfect report for regulatory purposes is very different from the perfect report for business intelligence.

## DISCUSSION

### WHAT HAVE WE LEARNED ABOUT BUSINESS REPORTING?

SAS® has become a valuable tool for data transformation and business reporting. In the SAS community, we are fortunate to have a huge and growing body of knowledge, largely from over 40 years of SAS as a company and 41 years – and counting – of accumulated papers from SAS Global Forum and other conferences and user group meetings which are freely accessible to all. This collection of ideas, advice and examples for data management, analysis, coding, program development and information delivery is a wonderful resource.

Experience and learning in business reporting is mainly in the areas of planning and report design, data, development and programming practices.

### Planning and Design

This includes requirements gathering, needs analysis and design and delivery considerations, as well as planning for development.

We begin with lots of questions:

- Who is asking for the report?
- Who is the report intended for? Who else is also likely to use it?
- Whose needs are we serving? Is the report intended to push or broadcast information from the requestor to their intended audience or is it to pull information from various sources for the benefit of the requestor?
- What was the request? Are there already similar reports being produced? If so, it's important to understand what's different about this request. This may be a quick way to identify both useful sources and possible limitations.
- Why is it needed? If the answer is complicated, it might prompt us to break the requirements into components and consider whether the need is for more than one report, although one process that produces different levels of summarization of the same information is not uncommon.



- When is the initial report needed?
- Will delivering a quick prototype help clarify or confirm the request?
- What are the expectations around how often this report – or some variation on it – will be needed? If there are already thoughts about needing variations this might influence how the process is designed.
- Are there expectations about the report format and mode of delivery?

Reality check: Based on answers to the questions above, is satisfying this request possible? If not, now is the time for negotiating a compromise. If satisfying the request does seem possible, then it's worth considering what extra value we might be able to add:

- Bringing business knowledge and understanding of the available data to the initial discussion is helpful. Be prepared to talk about what data is not included in the requirements.
- Are there related questions the requestor hasn't asked?
- What other information can we supply that would add value?
- Is there any room for creativity in this report? Some reports, especially those for regulatory or compliance reporting, or those used as input to another automated process, may not allow for any variation from a fixed format and method of classification. It's important to know whether our potential additions will be welcomed as added value or not.

## Data

After determining what the requestor is asking for we should also consider:

- Can we get the data needed to satisfy the requirements in a way that can be fully automated?
- Is it available at the level of granularity needed (or finer), reliably, in a timely manner?
- Are there data integrity concerns or a need to scrub the data?
- What else is in the data that is not addressed in the report? The requestor may not be aware of what is available or what might be incidentally excluded by their specific definitions. We may be able to add a more holistic view of the situation by slightly expanding the scope of what gets reported.
- Similarly, there may be segments of the data that are to be excluded from reporting, but the recipients should still be reminded of the exclusions so they don't take something out of context. This can be handled through documentation, narrative on the report or by including summarized "Unknown" or "Other" data as a category on the report.
- Data governance: Are there restrictions on who can access the data or how it may be used? Presumably, it would be appropriate for the people who have decision-making responsibility to have access to any relevant data but there may be regulatory reasons why some data within an enterprise cannot be shared with some areas of the enterprise.
- Is the data appropriate to the user? Is there a valid business reason for the requestor to see the information? Are there privacy concerns that need to be addressed?
- An expanded concept of metadata: Instead of accepting that metadata is data about our data, let's expand our view to make metadata information about data. Some tools make this easier than others but we need to find ways to associate information about the data with the reported data.
- Capturing and delivering Big Data is not an end. Learning to apply the insights we can glean from it can lead to great success. Successful exploitation of Big Data isn't a contest over who has the most data. It's about who can make better decisions based on the data they have.



## Development

There is relatively little growth in static business reporting in large, mature organizations. We may correct or customize or replace or reformat an existing report or look for a way to deliver faster, but there's not much call for innovation in business reporting. Mostly, the users will be able to tell us what their ideal business report looks like or what they're missing. After proper consideration of the user's needs, here's where we get to apply the techniques learned from lots of conference presentations and papers. In particular, there are lots of papers on coding:



- For efficient programs
- Making use of the features of SAS
- Using macros or procedures to standardize code so that common functionality is shareable and re-usable
- Making programs data-driven so that they can be fully automated and scheduled.

Often, users will focus on what the report should look like because that's easy – but we should focus first on what it is for. Consider what question(s) we are trying to answer with this report. The perfect report addresses the requestor's questions or needs but isn't limited by them.

There are also lots of papers on structuring and documenting:

- To make programs easily maintainable – modular and properly documented with explanation of not just what the code does but also **why**
- To make sure the report is self-documented for not just the initial requestor but also for future or unanticipated users. At minimum, users of the report need to know what is included, why it's included, and what's not included. An added bonus would be where the data came from, when each run was extracted.
- Perspective matters: Tell them what you're not telling them.

Finally, we've learned a lot – and written a lot – about how to implement sound reporting processes, including:

- Validation of data and results from our programs
- How to build production processes that can be fully automated to produce timely, reliable and repeatable reports. Credibility for business reports comes from consistency. Works of art are created once and can be enjoyed for an eternity but business reports need to be considered organic. A report is rarely really a one-off! The latest data gets stale in a hurry and there's usually an appetite for refreshed reports.
- Explain, explain, explain! Just as it's good programming practice to document code with an explanation of not so much **what** is done but **why** it's done, notes explaining a report should explain why. Recognize that a good report will very likely be shared with someone other than the original recipient or even the role you intended it for. This may be because a responsibility shifts from one individual or team to another over time or because the information gets shared with a wider audience for other purposes. Whatever the reason, the original intentions and design rationale are easily forgotten if they aren't permanently attached to the report. This can be done by embedding a cover page with usage notes, through footnotes or with metadata or a data dictionary embedded in each report file.
- Don't just be prepared to justify differences between new and existing reports. To pre-empt concerns about credibility, include the justification in the report file.

## Skilled People

We shouldn't take for granted the value of having the right people with the right skills, training, knowledge of the data and experience in designing, developing, testing, validating in order to deliver reporting.



## Technology

We depend on appropriate technology and reliable infrastructure to support our data storage, report preparation and delivery. The rapid evolution of technology has enabled – and sometimes caused, or at least contributed to the need for – the growth in business reporting. Business has moved from manual, paper-based reporting to fully automated data capture, manipulation, analysis and electronic delivery to users, wherever they may be, in a very short time.



This really encompasses the things we know about best practices for all aspects of programming and report delivery. We'll see later that what we've learned about creating business reports mostly applies to BI reports as well.

## MEANWHILE, WHAT ELSE HAS BEEN HAPPENING?

While we've been focused on what we can learn about designing, programming and delivering reports, there have been lots of developments in the rest of the world. Our work and life environments have changed and we've learned some things about cognitive psychology, neuroscience and data visualization that can help produce better reports.

### People are getting busier

People are really busy and their attention is a scarce resource. Many of us function in such a state of information overload that our default is to drop new information into our cognitive junk drawer. As our decision-makers get busier they are constantly bombarded with information about work and all aspects of life. Just like the popular media, we are competing for the very limited attention of our viewers. We are probably delivering business reports and BI on the same screens where our users receive other forms of news and even entertainment.



Keep in mind that **communication** requires not just delivering information but also making sure that information is **received** in a way that makes it understandable. The human mind likes to categorize things into memory. Unfortunately, innovative ideas may not arrive in a form that's easy to categorize along with our routine tasks.

## Learning from Cognitive Psychology

In "The Invisible Gorilla", authors Christopher Chabris and Daniel Simon use the results of psychology experiments to demonstrate the limitations of human memory and intuition. They describe several common illusions of thought and memory we are all subject to:

- Inattentional blindness describes the inability to notice what we don't expect to see while we are fully focused on looking for what we do expect to see. The human brain actually doesn't see some things that are in clear sight when the attention is sharply focused on looking for something else. We also have difficulty acknowledging that there are things that perhaps should be obvious but that we don't see.
- Intuition can be deeply deceptive because it may confirm our biases or beliefs. So, although many decision-makers rely on it, intuition may actually hinder decision-making because of confirmation bias.
- The illusion of confidence describes how we believe that those who are most confident are also most competent. Studies show, however, that confidence in one's own memory or ability is not a reflection of competence.
- The illusion of knowledge tells us that we think we understand things that are familiar or



common because we recognize them. Recognizing is different than understanding how and why. We tend not to question our own knowledge until it is challenged by five-year-old, we have to defend it in an argument, or when we try to explain it to others.

- The illusion of narrative means that through a series of factual statements, an author can strongly influence what we infer from what is stated and what is not stated. We need to be especially careful to avoid inferring cause from coincident events and to maintain proper sequence in narrative.
- The illusion of memory is that most people's memory is not as good as they believe it is. Most people significantly overestimate their ability to remember and are fully confident in facts that they mis-remember.

Considering these illusions and the impact they have on each human's ability to notice things, recall those things accurately, understand them, make inferences from them and recognize their own limitations should remind us how fallible the human mind is. Anyone who doubts this should watch a short YouTube video on "The Monkey Business Illusion" that illustrates some of Simon's work. (See URL in References section.)

## Data Science

Data science has been around for decades but the widespread exploitation across business functions has exploded in recent years, especially as Big Data has become readily available to us. The practice of data science is highly labour-intensive because it's research- or experiment-oriented. In a brief but contentious Harvard Business Review article, author Stuart Frankel claims that data scientists don't scale. He's correct, in the sense that original research can't be initiated in an automated way – yet – but that doesn't mean that the results of data science can't be incorporated into automated reports. The knowledge that is the end product of that data-scientific research can certainly be integrated into our automated production reporting processes. Full automation of the research is not beyond imagination, just beyond practice today. **Unknown is not the same as impossible.** Who would have expected, in the time of purely manual business record-keeping, that we would be able to produce the sort of business reports that are common today?

## Visualization

We've become more adept at using visualization and graphics in reporting. This has raised the bar as we compete for attention. Unfortunately, it can also be distracting. We should communicate information in the way it can be best absorbed by the recipients, whatever that is. Don't feel it's necessary to match the look and feel of other reports unless there is a definite requirement for the information you deliver to blend seamlessly with other reports. It's okay to create a report that stands out if it's for the right reasons.



Some BI tools are primarily data visualization tools. Visualizations are good for some things and preferred by some people, but they are not necessarily always the best way to communicate:

- Visual analytics is excellent for data discovery and also for very quick, high-level results, but for not necessarily good for delivering intelligence, unless the image is the answer.
- Info graphics or storyboards are an appropriate medium for a high-level view; the viewer can observe and form an impression very rapidly. They can convey simple information — or complex impressions — quickly and very well. They may not be so good for more detailed information. Visualization doesn't necessarily lend itself to decision-making.
- It may be difficult to share a story that makes the impression memorable. The path from the information or impression to a decision and ultimately an action might not be direct.
- In order for graphics to be useful and not misleading, scale, consistency and context are especially important.

- Some people prefer a visual overview and other prefer text.

## HOW DOES PERFECTION RELATE TO BI REPORTS?

The terminology may be different but BI reporting – although it may be slicker and faster – relies on the same fundamentals as business reporting. **Most of the lessons we've learned and use for business reporting are essential for BI reporting.** Planning, design, good data, sound programming and development practices and appropriate skills are every bit as important for BI. Sound business reporting practices are assumed to be in place before we consider BI reporting. They form the sometimes overlooked foundation for BI. We may depend on newer technology that easily supports BI practices. There are, however, some differences in the ideal content for BI and how reports may be tailored. A perfect BI report must be based on complete, accurate and timely information, delivered to the right person, at the right time, while respecting the time and attention of the recipient and giving that person the knowledge they need in a way they can act on.



True BI requires that we transform business information into actionable knowledge. The best way to do that is to integrate measurement, context and – if possible – recommendations for action. Many of us are already starting in a data rich environment. Just reporting on the data in that environment is not enough. We have to look at where we can add value. To do this, we should clearly define:

- Who is **the intended recipient**?
- What specific situation the report is intended to address?

The answers to these questions will help distinguish business reports from BI reports. As discussed above, there are business reporting requirements, including regulatory or accounting reports, where straightforward presentation of information is the only appropriate content. So, we need to determine whether a more creative report is suitable. Should the report be purely informational or should it motivate action? BI reports should be more active rather than passive.

- Instead of beginning the process of designing and developing a report with the question, "What do you want to **see** on the report?".
- Try asking, "What do you want to **do with** the report?".
- Or even better, "What will you **do because of** the report?".

If we can identify the action needed for success in their role then you can look for the best information to support the action. Often, there will be decision-making involved, but the decision is just a step toward the necessary action.

Looking back at our definition of perfect, we know that perfection requires an excellent fit for the situation. To achieve that a perfect BI report should:

- Meet the recipient's needs for actionable knowledge
- With the complete set of information that's relevant to the situation
- Based on complete and accurate data.

Perfection has to do with thoroughness and satisfying needs. So, our perfect report should be based on complete, thorough and accurate underlying data. There's no reference to niceness or happiness in perfection. Some of our perfectly accurate data may represent bad news, but there are still ways it can be helpful. If the reality is less-than-wonderful news, knowing the reasons behind it, when it might be expected to change or what our decision-maker can do to improve the situation or minimize the impact would be valuable.

Although it's always nice to receive good news, our responsibility is to make the decision-makers more effective by delivering actionable intelligence. Sometimes, the best report doesn't show the "best" results. It may illustrate that things are not going the way the report recipient would like. In those cases, the most useful information would be why things aren't going well and what could be done to improve the situation.

## Considering the consumer

We should treat of our intended BI report recipients, who are our clients or our audience, as **consumers** and "market" the knowledge we want them to notice and act on.

**"If you chase two rabbits, you won't catch either."**

There was a time when one report had to serve many purposes. Report development was a lengthy process and delivery of periodic reports was slow. Most organizations had an enormous backlog of unfilled reporting requests, so there was an emphasis on "monster reports" that tried to anticipate and answer every possible request based on the same data – whether that made sense or not. We've progressed to the point where we can move toward customization to the recipient and their needs rather than automatically supplying all combinations of information in hope that what's needed gets included and that the recipient finds the information and generates knowledge from it. That customization will allow us to create a perfect report to support a specific person's needs for knowledge and action.

Our perfect report would fully respect how valuable the time and attention of the consumer is and deliver actionable results with as little distraction as possible. Note that this is nothing like the sort of self-service query result offered by most BI tools. A perfect BI report would be far from it. We expect the tool(s) used to prepare BI reports to have

- The speed that is currently typical of BI tools
- The functionality to combine data that is typical of our current business reporting tools but not yet of BI tools
- The flexibility to tailor the aesthetics that is common to our business reporting tools.

Even with all that, the BI tool won't transform data or information into knowledge. We need to work with the consumer to figure out how to deliver knowledge or deliver information they can convert to knowledge through their own process.

## Getting comfortable with predictions

Does the perfect report give us history or predict the future, or both? Most business reports demonstrate where we are now (from actual measurement) rather than where we are headed, even though what is likely to happen next may be more important.



Let's consider an example from everyday life, where most of us have a need for information we can act on: The weather. We can't plan the weather or change it but we can prepare for it and mitigate the impact on us from day to day. There are lots of historical measurements available and those may be interesting but they aren't particularly helpful on a daily basis. Before stepping outside, we'd like to know the weather right now, but we'd probably also like to know what is predicted for the rest of the day so we can plan accordingly. Knowing what the weather was yesterday or on this date last year is not the best information to use when deciding whether to carry an umbrella or sunglasses today.



A weather forecast that always predicts a beautiful day isn't helpful unless it happens to be entirely accurate. If rain is expected today, we'd be better off knowing whether the rain has already begun or when it is likely to begin, how heavy it is expected to be, when it's likely to end and what the overall probability of rain is for the day. That information, even if it's mostly predictive, is the best we have to prepare ourselves. Knowing what weather is expected next week or next month may be actionable intelligence for people planning events or operating a business that is weather-dependent, but most of us just need to decide how to prepare or adapt for today. What we want is the most complete information available to support our decision-making and action. In the case of a weather forecast, most of us are comfortable with predictions based on the knowledge of a meteorologist, knowing that those predictions are based on valid models and good data and are available in a timely manner.

Computer-generated reports are expected to have some inherent accuracy and objectivity because they are data-based. It's therefore especially important to clearly distinguish between facts and any subjective or predictive information that is included along with our facts.

## **HOW DO WE APPLY EVERYTHING WE'VE LEARNED TO PERFECT BI REPORTING?**

With the right tools and BI practices in place, there's lots we can do to provide a perfect BI report for a particular consumer and situation.

### **Separating data-handling from decision-making**

We have massive amounts of data, with vast potential for discovery but we get hung up on reporting on our data rather than learning from it. Some of the entities we call business reports (or even BI reports, inaccurately) are really proxies for databases. They deliver a lot of data – nicely packaged and summarized but still data that's drillable – to the user. So we are still expecting our business experts and decision-makers to deal with data. In many organizations, the norm is a backlog of requests for business reports that has taken a ridiculously long time to address because of delays in getting access to the data and a shortage of people to fulfill the requests. A common approach to dealing with the huge backlog is to put tools into the hands of the decision-makers so they can satisfy their own needs. Instead, we should be looking at how to make those decision-makers more effective. This doesn't necessarily mean delivering data to them or giving them the tools to analyze data. Data was – and still is – the raw material for computerized reporting. Out of necessity, our earliest efforts were around acquiring and manipulating data. In time, we learned to convert data into information, which is much more easily digestible and meaningful to the consumers. With Big Data, we have many sources creating data, we have the technology to acquire and store that data, and we have the tools to quickly convert that data into information. What we still need to tackle is moving that information up the hierarchy to where it supports action. Intelligence is the transformation of information into knowledge we can act on.



Having data that's accessible is a fine thing but it shouldn't be the endpoint of our efforts and it shouldn't be confused with delivering intelligence. We would like our decision makers to make evidence-based decisions, but that doesn't mean they have to handle the evidence themselves. Data discovery can be a very valuable exercise but it shouldn't fall to the decision-maker to do. Separate data exploration from decision-making and action. If we're talking at the level of metrics, we're not talking about actionable knowledge. Our decision-makers, or BI report consumers, must appreciate the results of good data and information management.

We don't want to eliminate access to details but should recognize that most decision-makers don't need to see the details themselves as long as they can trust that the details (data) have been transformed and represented appropriately. Researchers need data. Administrators need organized details. Decision-makers can gain knowledge from information or advice that's based on good data – but they don't necessarily need to see the underlying data. Focus on what the report consumer needs to make decisions and don't deliver excess information just because it's easier to do so. Self-service reporting and repeated reviewing of details can be a waste of their time and attention.

### **Respecting attention and its limitations**

Part of our challenge in delivering BI reporting is to make sure the communication is received in a way that makes it understandable and actionable by the human recipients and not just the machines we display it on. Technological memory and resources are easily expandable; a human's resources are not. Inattention blindness means that a human user of computer-generated reports – even one who is knowledgeable about the subject of the report and “good with numbers” – can easily be distracted by their focus on what they are looking for and miss the opportunities. People naturally pay attention to the thing they are looking for and may literally miss a gorilla in the room. We can help by including reminders of what's expected, highlighting the unexpected, explaining situations and what the options are, and including careful narrative. Attention is a valuable resource and it shouldn't be wasted. We need to be selective about what we routinely put in front of people to make sure they are able to use the highest priority knowledge we can supply.

## Including context

We should include as much contextual information as possible with our reported results to minimize the reliance on the decision-maker's attention, memory, understanding and inferences. For example, if we are reporting actual measurement results for a business quarter, some or all of these values might also be helpful, depending on the business circumstances:

- Actual results for previous quarter(s), for the year-to-date, for same quarter last year, for the full year last year
- Budget for the quarter(s), for year-to-date, for the full year
- Forecast for the this year, projected from actuals for the past time periods and budget for the future ones
- Industry data (possibly proprietary) for current quarter, last year, this year-to-date
- Other external data – economic indices, etc.

In addition to an appropriate level of quantitative information, we can include commentary to give additional context. Embedding relevant context in our reports reduces the risk of a bad decision based on common illusions and saves time for the report consumer. Our decision-makers shouldn't have to spend time foraging for details even if they are aware that they don't know them or aren't certain of their recall.

Just as our stakeholders have demanded data integration, we need reporting integration to combine

- Targets or budgets – what we initially planned to achieve
- Measurement – what results we have achieved so far
- What factors have affected that achievement
- What we expect to achieve – in light of the measured results so far
- What we predict about how to achieve.

It's important to make external data and narrative available to be integrated into our reporting because understanding how effective we are in business and knowing what we are not doing allows our decision-makers to recognize new opportunities. The relevant external information is especially situation-specific and time-sensitive, but what we as an industry have learned about managing big data should help us make such information available for reporting.

## Delivering knowledge specific to the need

Data – and good data management and transformation and information delivery – is the means, not the end product. As we gained access to more data and worked through the backlog of demand for reports, there was a tendency to churn out lots of reports and make lots of data available to decision-makers – because we can. Once a process is developed it is quick and easy to deliver reports and data, at regular intervals, at multiple levels of granularity or summarization. Reporting on lots of general information is like scattering birdseed, hoping that if enough gets distributed then everyone will find what they need to survive. A scattershot approach to distributing lots of information and hoping the right knowledge gets to the right people doesn't make sense for BI consumers. Nor does a generic report. So, we need especially careful consideration of each consumer's specific needs and preferences.



## Finding the right time horizon and delivery style for the situation

A perfect BI report is extremely specific to a situation and a person. There will be some underlying performance indicators that are common but not every decision-maker needs the same information or knowledge to make the best informed decision. Needs are subject to individual memory, knowledge and emphasis on relative importance of factors.

"Just because we can doesn't mean we should."

With the proper tools and environment, we could deliver BI reports from repeatable, automated processes rapidly and **frequently**. Because it's easy does not mean it's the right thing to do. Appropriate frequency and mode of delivery needs to be considered in the context of the intelligence to be delivered and what decisions and actions are desired. What time horizon makes sense? Just because we can push hourly or daily updates to mobile devices for our users doesn't mean it makes sense to do so. That depends on whether an immediate action is necessary or even appropriate. Most high-level decisions are long-term and strategic and they deserve careful attention and consideration. Knowing what's happening minute-to-minute or day-to-day is not necessarily valuable for the decision-maker and it may be an unnecessary drain on attention. Of course, the needs of someone who is making operational decisions that involve possible immediate interventions or corrections are very different and may require frequent updates with time-sensitive information.

For example, we may be deriving some measurements from transactional data and we may have a rolling 3 years worth of that transactional data available to us. We could report on any or all of:

- Transactions summarized by year plus current year-to-date
- Transactions summarized by quarter plus current quarter-to-date
- Transactions summarized by month plus current month-to-date for this year
- Transactions summarized by week plus current week-to-date for this year
- Transactions summarized by day for this month
- Transactions summarized by hour this week.

There isn't a right or wrong degree of summarization here but there are appropriate levels for different kinds of decisions and actions. Staffing levels may be very time-, day- or season-specific but product decisions may look at a much longer term.

For example, it's important to have a concise and factual report, perhaps delivered to mobile devices, if key decision-makers convene for an early morning meeting every day to decide on an action plan for the day. They need headlines and highlights from the past 24 hours and maybe also some trending data. The report content and means of delivery should be different if they're having an annual meeting to set strategy for the next year and beyond. For longer term, more strategic functions, longer trends and less frequent checkpoints are more appropriate. Daily trends and variations would be a distraction. If they can't or won't initiate action at a given time, what is the point of receiving reports then?



What sort of delivery format makes sense for the nature of the action required? For quick, short term decisions, like what needs to be the priority in a daily status meeting, rapid receipt and the convenience of the consumer is key. For more serious, long term decisions, delivering results a way that encourages the decision-maker to give them more careful consideration makes sense.

## Incorporating Data Science

It's time to get comfortable with including **science** in our reporting. Innovation requires making decisions based on probabilities and predictions and not relying only on historical facts. This is accepted practice in many disciplines, where absolute measurements are not available in advance of decisions, but reliable evidence is. We seem to be shy, in business, about presenting facts and predictions together, even though they are both used to make decisions. Those decisions, based on science, are happening now but without transparency. It would be better to acknowledge and consolidate all the information and knowledge and evidence that's used to decide to take action into structured and automated reporting and not depend on human memory and intuition.



If **science** is the pursuit of pure knowledge and **technology** is the practical application of that knowledge to create a product, then a perfect BI report would come from the intersection of the best of data science and the best of information technology. It's not a slick name but it seems like that should be called **data technology**. This data technology is a new idea. We don't have the ability to easily build the experimental aspects of data science into our reporting yet but with a little creativity, we can incorporate the results in our reports as recommendations. Of course, experimental results need to be clearly identified as having a different nature than our retrospective facts.

If predictive results from data science are to be incorporated in our BI reports, it's especially important that they come from fully-automated and reproducible processes without intervention. The learning from data science may continue to evolve but delivery of timely BI reports depends on automated, repeatable processes. That means capturing the learning up to a point and applying that to our reporting until the next capture.

## Identifying problems and recommending solutions

Traditional information delivery has been about delivering measurements as our end product and letting the report recipient use those to identify problems. We could just as easily identify problems in an automated way and offer predictions or recommendations or even propose solutions. What if, like non-automated, human-written reports outside of IT, our reports gathered facts and presented analyses and recommendations? Including recommended actions makes it easier for the decision-maker to take appropriate action. Of course, we'd need to capture those recommendations in a fully-automated, quick, hands-off and repeatable way. If we can programmatically determine a recommended action, why not supply that to the user instead?

- In the simplest cases, embedded recommendations could be derived from a decision tree.
- In slightly more complex cases, code or messages could be generated based on data, and included as recommendations.
- In even more advanced cases, data science results based on learnings from historical data could be incorporated as recommended actions.

If including recommendations is not feasible then we could at least identify possible courses of action.

As individuals who create such reports, we would need to earn respect and trust for our recommendations.

## Curating knowledge for action

Be selective! No one really wants to see another screen full of numbers. Even though we've just discussed lots of possible additions to the context we deliver on a perfect BI report, it's important to target what the consumer needs and wants and not try to assemble everything possible – just everything that's appropriate for consumer to take informed action. We must de-clutter and filter out excess to help the recipient focus on what's relevant and their best opportunities for action. Less is more when a task requires the full attention of the consumer.



How do we integrate this expertise for the end-users of BI reports rather than delivering well-dressed but generic data? By **curating knowledge** for decision-makers. We have experts in technology, data acquisition, data architecture, data management, analysis and delivery and in business. With skill and practice, we can develop experts to compile relevant knowledge, predictions, ideas and recommendations from various sources and deliver them organized in a way that a busy person can handle more easily than receiving a greater volume of generic information. This is a much more holistic view of report preparation than we usually consider in IT. It involves gathering information we believe is relevant and might be of interest to our target BI report consumers, to assemble information and ideas.

The approach is similar to the way people may now choose their entertainment; more on-demand than scheduled network offerings. The focus on whose needs we are serving is different when we're delivering curated knowledge. There may be a greater cost but it's a more personalized service. Treat the BI report like a premium news feed, supplying everything the consumer needs to know to make

decisions – subject to appropriate timelines, of course.

## How do we put all this together?

We have to change a lot the way we think about reporting to apply all these changes.

- As we integrate more and different data sources, we to avoid get bogged down waiting for data. It is important to be transparent about the currency of data but as with any sort of decision, the decision-maker must act with the best knowledge that is **available** at the time a decision is required.
- Similar to the way we may see people organized into cross-functional teams to bring together the skills and knowledge achieve a better result, we may need imagine cross-functional reports to help make BI results actionable. Such reports would integrate (actual) performance with (predicted) possibilities for a product or segment, for example.
- Logistically, the reports would have to be structured differently to accommodate predictions, which might be at a product or segment level, for example, with performance. Some knowledge doesn't exist or wouldn't make sense at the same levels of granularity or summary. Predictions don't always fit as line items. Linking or hyperlinking the information and knowledge together can make the actions more accessible to the report user. Instead of drilling down into data, we'd be linking up (or out) to other resources.

## WHAT'S NEXT?

BI tools are still maturing. The current generation of give us the ability to rapidly manipulate massive amounts of data but they don't have even the full flexibility we have with our business reporting tools. Meanwhile, we have smartphones and tablets that let us customize our interactions and displays. In the future, the perfect BI report would be whatever the report consumer needs, whenever they need it and looking however they want it to look. It would let the consumer customize their "feed" to provide the perspective they need and prioritize the knowledge they need to support their work; a flexible, dynamic, curated **knowledge surface** for our BI consumer to assemble dashboards or pinboards from BI tools, desktops and storyboards, news feeds, social media streams, reminders and reference materials, and alert them to updates.

We need to keep in mind that the reports we produce are the means and not the end. Although IT's accountability may be to deliver accurate information to the right people at the right time, that's just the beginning of a process. Those people need to find time to look at the reports and the attention to focus on what's important. They need to identify the information necessary to make decisions and then make those decisions. The desired result is action based on the contents of the report, not simply delivering the report with the hope that someone will look at it.

We know that delivering knowledge is more valuable – and also more complicated – than delivering information, but we can work on it. As data science and machine learning develop we may even be able to deliver wisdom to our BI consumers.

## CONCLUSION

A perfect BI report adds value by supporting a decision-maker in a specific situation, allowing them to act swiftly with the best available knowledge. It's still early in the evolution of BI reporting. We probably don't have the skills or the tools to create a perfect BI report today. Knowing that we can't achieve perfection -- yet -- is not a reason to avoid creating better BI reports. Perfection can be aspirational and inspirational.

**"Don't let the perfect be the enemy of the good."  
-- Voltaire?**

By building on our knowledge and experience from data management, business reporting, information technology, data science and what we can learn from other disciplines, we can compile the best available information and knowledge to support business decision-makers. We can work toward giving them



everything they need to make a given decision in one place at one time.

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## CONTACT

Your questions or comments about the content of this paper are welcome.

Lisa Eckler

[lisa.eckler@sympatico.ca](mailto:lisa.eckler@sympatico.ca)

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