Business Intelligence (BI) – data as a new resource of an organization

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Contents

[1. Preface 2](#_Toc499724107)

[2. Introduction 3](#_Toc499724108)

[a. Definition of Business Intelligence. 3](#_Toc499724109)

[b. Impact on the business. 4](#_Toc499724110)

[c. Overview of applications. 5](#_Toc499724111)

[3. Basics 7](#_Toc499724112)

[a. Components of BI. 7](#_Toc499724113)

[b. Glance over the technologies 10](#_Toc499724114)

[a. Business examples of Success and Failure. 13](#_Toc499724115)

[4. Intelligent Business with examples of technology stacks 15](#_Toc499724116)

[a. Reporting 15](#_Toc499724117)

[b. Prediction 16](#_Toc499724118)

[a. Identyfing possibilities 18](#_Toc499724119)

[5. The future is intelligent 19](#_Toc499724120)

[a. The hidden potential 19](#_Toc499724121)

[b. The development of technology 20](#_Toc499724122)

[6. Bibliography 21](#_Toc499724123)

# Preface

**Business Intelligence** has held its position as not only a trend but a standard business solution for a long time. Simultaneously, the experimentality and risk of this technology have faded away giving place to major institutional investments and global standard of doing analytics. Nowadays every firm keeping up with the modern analytics race has its own CIO and a major share of its capital set aside for development of a BI system.

Unfortunately, the sudden advancements and hype surrounding the technology have resulted in a dilution of the term and transformation into a buzzword used for every minor type of IT related system a business employs. More often than not we can see a situation where a question “What is Business Intelligence?” is answered with a plethora of explanations not rarely contradicting each other. I would like to act as counterforce to this unsettling phenomenon. The aim of this paper is to organize and clarify the term “Business Intelligence” to the reader. Simultaneously, allowing him to identify the problems the technology can solve and use the methods BI offers to solve the aforementioned problems.

**The paper** is structured as follows:

In the introductory chapter the term “Business Intelligence” is defined. At the same time the general philosophy standing behind it is explained. Ending with a quick overview of the impact the technology has already done in the industry generally speaking.

The Chapter “Basics” presents the internals of BI system. We start off with structurizing the construction of a typical BI system. After that, the process of implementing such structure is described. The chapter is summarized with business cases presenting both successful as well as unsuccessful stories of firms trying to take advantage of the new way of doing analytics.

The third chapter is centered around different methods a functioning intelligent system offers to the business using it. Group of problems is presented, every one of which coupled with a functionality of a BI system. Method of exploiting the functionality to successfully solve the problem is intuitively explained backing the case with a real-life example.

In the end a quick glossary of current trends and possible future developments is stated. Additionally, a light economical analysis on the potential of future investments is made.

# Introduction

## Definition of Business Intelligence.

**We live in an information age.** What does it mean? It means that just as the knights of the medieval age measured their wealth with land in their possession or the entrepreneurs of the industrial age with capital the modern value comes from meaningful information.

Every type of modern organization is drowning in information. The modern era has brought upon us the need to use electronic devices for every type of operation we do within a business. This in turn spawned a waterfall of transactions records, customer’s profiles, clients’ feedbacks and many more bytes of endless data stream.

As the time passed some more innovative firms have spotted the potential this data stream holds. It has been pointed out that usage of data could allow, for example, for employment of statistical methods to predict, within some range of error, the future behavior of a customer. After decades of hardships and efforts trying to implement the great idea we are currently able to witness the rise of an entity which is currently the main driving force of the current information revolution. That is, Business Intelligence.

**The term** has been defined already many times.

Madsen’s (Madsen, 2012) definition goes as follows: *“BI is the integration of data from disparate source systems to optimize business usage and understanding through a user-friendly interface.”*

Howson (Howson, 2014) described it in following matter: *“Business intelligence allows people at all levels of an organization to access, interact with, and analyze data to manage the business, improve performance, discover opportunities, and operate efficiently.”*

The last good example is given by Moss and Atre (Larissa T. Moss, 2003): *“It is an architecture and a collection of integrated operational as well as decision-support applications and databases that provide the business community easy access to business data.”*

There is only one property I would like to underline given the definitions above.

**BI does not equal IT**. BI is a set of high-level processes which only partly employ computer technologies. The most vital part of BI is not the biggest amount of the best data or the most efficient and the smartest algorithms on the quickest machine but the human understanding of business environment in which the BI is employed. You cannot predict the behavior of a customer if you do not know who your customer is.

## Impact on the business.

*“****A key sign*** *of successful business intelligence is the degree to which it impacts business performance, linking insight to action.”* This quote by Howson (Howson, 2014) lays ground for a method allowing us to measure the impact of implementing BI in a company. The goal of an owner investing in such a technique should be that simple formula. That means, he should measure the effectiveness of his new system by comparing the state of processes after the implementation with their state before the implementation.

“Transforming Data With Intelligence” (TDWI) Best Practices report (Practices, 2017) gives us insight into the current state of industry and how it has been affected by the BI. The statistics are as follows:

The pie chart above is a summary of answers from 189 respondents, every one of which being a running company. The question given to respondents went as follows: *“Over the past 12 months, are your organization’s newest BI and analytics projects delivering their intended business value at a faster pace, at about the same pace as the previous 12 months, or at a slower pace?”*

Clear division is seen. The effect of BI has been positive in 50% of the cases but also nonexistent in the other 50%. The numbers might be discouraging but we have to take into account other factors. Incorporating BI into your business is not an easy task. The technologies are very fresh, almost experimental, and the number of professionals in the field is far from sufficient. We have to realize that of 50% of companies not receiving benefits from the investment a big chunk has simply not completed the implementation phase and could not receive any of those profits. Reevaluating the given statistics, we should realize that the industry gives us proofs for the following statement. BI increases the pace at which projects deliver value but at the same time implementing such an improvement is a challenging feat.

## Overview of applications.

**BI has proven its worth** already in numerous branches of the world economy. Most of us do not realize how widespread the technique actually is. The list below is supposed to acknowledge the reader of different usages of the technology backed by examples and key factors allowing for improvement of business processes.

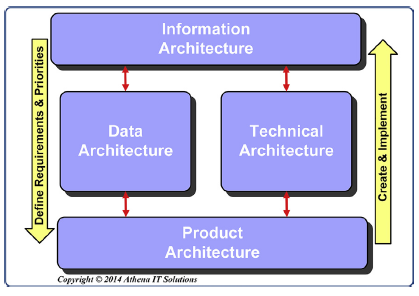
* **Management and Control** – Most people do not know that a typical manager does not control what happens in his company, from financial side, until the publishing of quarterly reports. In this situation one has no possibility of reacting to misuse of company’s capital because by the time it is known the source of problem has already evaporated having exhausted resources of specific area of the company. BI is remedy for that problem. Granting the managers, a constant, clear and intuitive insight in the company’s stream of money and resources.
* **Improving Performance** – Pareto rule states that 20% of your customers generate 80% of your revenues. Every entrepreneur would like to take advantage of that by identifying which customer exactly is that and offering him even more products or by analyzing the inactive 80% and trying to activate their consumption efforts. Even tough the idea may sound easy it is almost impossible in the modern world of global multi-channel sales. Once again BI comes to the rescue organizing the data and taming the chaos.
* **Operations** – Every person has his favorite bakery. Every person also complains more or less often about the shortage of his preferred product in this special bakery. It is more reasonable for baker to bake too little and sell everything than to bake too much and throw away the wasted capital. Most of bakers also do not posses Ph. D. in statistics and are not able to predict very well the future demand. The solution? BI! Integrated systems can let everyone use the state-of-the-art algorithms with one click of a mouse. No more shortages of sweets!
* **Process Improvement** – The new technical report has shown that the assembly time of a specific machine takes twice as long as it’s supposed to. Outrage among the board calls for an urgent action. Team of engineers is ordered to leave their current duties, slowing the other respective processes, and to find the source of problem. They spend a month going trough every part. Finally, the problem is found. Couple of loose bolts. The engineers come back to their long-forgotten divisions. What is the modern approach? BI using the IoT to monitor the state of every device in the factory and signaling every smallest malfunction, which can be repaired within minutes by a simple line worker.
* **Customer Service –** Unfortunate series of events leads to a streak of warranties from one specific customer due to malfunction of every product he bought. Typical company would lose that man in stream of thousands other customers leaving him unsatisfied and more than ready to explore the offer of our competitors. Company employing BI would easily find that one customer and offer him special deals letting him enjoy a special care.

**We go one step further** and research areas of life not connected with strictly money-earning companies. Data has found usage in many seemingly analytics-unrelated organizations. The following list showcases the most interesting examples.

* **Public Institutions –** We live in times where it is more and more often possible to say that a computer has saved someone’s live. Madsen dedicates are whole book to exploration of usage of BI in hospitals. We can see fire departments, police stations, public transport services and many more all around the world using BI to deliver their services better without outlook for profit.
* **Sports, Politics and Everyday Life –** It is only possible to guess whether Donald Trump has won the elections thanks to the magic of predictive analysis. But, it is a clear fact that data is used by politicians, sport managers or scientists to make their work more efficient and achieve what has never been achieved. Even though the subjects enumerated here possess little to no similarities with companies mentioned earlier, they also take advantage of BI. What follows is a simple conclusion. BI can be actually used by everyone and does not have to be a millions-worth contract deal. For example, even mobile apps tracking your jogging statistics from which you are able to improve your training sessions could be called BI.
* **Science –** The source of all of the clever methods and technologies granting semi-magical powers to the world is certainly also one of the beneficiaries. Using data for research is an idea as old as the research itself. What is new is the tempo at which business cooperates with academia and drives its progress. At year 2012 the first deep neural networks showed their power winning the ImageNet challenge (ImageNet, 2012) and proving that a computer can achieve better result than a human being at a cognitive task. We needed only 3 years for a computer to become the greatest Go player (AlphaGo, 2015). That would not be possible without major involvement of business interests.

# Basics

## Components of BI.

**As stated earlier** BI is not simply IT. There are far more business-related intricacies involved than the everlasting hype suggests. In this chapter I would like to present all of the members of a set we call BI. I will support myself with a diagram used also by Sherman (Sherman, 2014). The structure of BI could be depicted as follows.

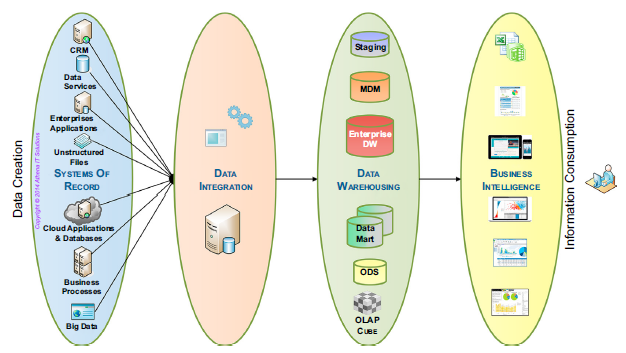
This paper encompasses only the definitions and explanations of the terms seen above. Reader willing to deepen his knowledge is redirected to Sherman’s book. (Sherman, 2014)

**Information architecture –** The layer could be compared to requirements definition used in software development or a business plan. The aim of this architecture is to answer the following questions:

* **What** business processes or functions are going to be supported, **what** types of analytics will be needed, and **what** types of decisions are affected.
* **Who** (employees, customers, prospects, suppliers, or other stakeholders) will have access.
* **Where** the data is now, **where** it will be integrated, and **where** it will be consumed in analytical applications.
* **Why** the BI solution(s) will be built—what the business and technical requirements are.

The point of this theoretical discourse is simply to realize what do we want and how are we going to achieve it. Exactly as the requirements definition and business plan it is the single most important step in the implementation of BI. Unfortunately, it is also the single most ignored one. If the company sets out to employ this type of investment not preparing beforehand it’s future destiny is purely luck dependent.

**Data architecture –** Having prepared our information architecture we are ready to start delving into the real implementation. The first step being definition of the type of our data and how it will be transported from the source to the end user. The general schema one should follow has been already defined in the industry. I will once again support myself with Sherman’s diagram (Sherman, 2014).

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Even tough very explicit the diagram requires explanations of every stage.

* **Data Creation -** Every type of data has its source somewhere. In the past those were, for example, banking systems saving every type of transactions which they have done. Nowadays, thanks to the development of IoT, it is reasonable to state that every type of electronic device is a source of data.
* **Data Integration –** Logs of banking transactions from two different systems, even tough possibly pointing to the same entity, might be represented in totally dissimilar formats, sometimes even holding different information. That type of data is called raw data. To be of any use the vital parts have to be extracted. That is the job of a data integration layer. Different types of software, for example ETLs (Extract – Transform – Load), are used to format data into the form defined by Information architecture.
* **Data Warehousing –** Having prepared our fresh data we must secure it somewhere where it will be ready to be easily accessible by analysis tools. As easy as it may sound the task grows harder and harder as we try to store more and more diverse data in ever growing amount. The old proven solutions such as relational databases have given place in some areas to new experimental methods which cater to more specific needs. Example could be a NoSQL technology which has been specifically designed to hold vast amounts of data.
* **Business Intelligence** – Finally, it is time to reap the fruits of our hardships. With well structured and readily available data we ready to employ the algorithms which in turn will empower our process to bring appropriate profits.

It is very important to underline the fact that the Data architecture can not be well implemented if it does not comply with the Information architecture.

**Technical architecture –** Thethird step in an implementation process is planning out the software we will use. Quick summary of the technologies used is given in the next subchapter.

The one important matter to note are the two main strategies of implementing such architecture.

1. **Usage of all-in-one systems –** Those systems are for example Enterprise Resource Planners(ERP) which cover all of the layers in the Data architecture and thus require from the investing company only the need to adapt the system and then train the personnel to use it. They are developed by external companies and are sold for big sums of money. Such solution suits well businesses with very common needs. The reason being, the economics of scale, which allows them to buy the system for a price far lower than the cost of own development.
2. **Usage of self-made systems** - If the company is either small and its BI requires only humble amount of small software or its need are very specific and not covered by the market products it could be possible that implementing every layer of architecture by itself would be much more reasonable.

**Product architecture –** With all of the specifications ready it is time to choose the actual software, hardware, configurations and the strategy for maintaining the whole structure. It is of utmost importance that this part should be completed as the last one. Otherwise, we could end up spending money on products with features we do not need or products not fulfilling our needs.

## Glance over the technologies

As there are many technologies used repetitively in different BI processes it is worth stating what comprises them. The description will consist of the purpose of the software, main strategies of usage and examples of modern industry solutions.

* **ETL (Extract, Transform, and Load) –** Software bringing order into chaos. Designed to extract standardized information from raw data. Allowing us to easily store and analyze data coming from different sources.

As stated at the site etltools (etltools.net) so far 4 types of ETL tools have emerged.

* + **Tools that perform and supervise only selected stages of the ETL process**, such as data migration tools (EtL Tools or *“small t* tools”) or data transformation tools (eTl Tools, *“capital T* tools”).
  + **Tools that offer complete solutions** (ETL Tools) and include many functions intended for processing large amounts of data or more complicated ETL projects.
  + **Code base tools** is a family of programing tools that support many operating systems and programing languages.
  + **GUI-based tools** remove the coding layer and allow users to work without little knowledge of coding languages.

ETL tools can be also differentiated by the way they handle updates. The old way consisted of simple batch updates which happened every regular period of time. The modern solutions allow for much bigger elasticity as the technology starts moving towards cloud and better algorithms for changes detection are being developed.

One good example of such tool is Apache’s Kafka (Kafka).

* **Data Warehouse –** Data is only powerful when you have got loads of it. To achieve that you have to store it. The idea is far more complicated than it may seem. The times of relational databases as the only needed solution are far gone. As Sera (Sera, 2014) states in his blog we can see a shift from Enterprise Data Warehouses (EDW) to Data Warehouse Environments (DWE). That means we stop holding all of our data in one place and start using distributed systems to relocate it to many different locations. The reason is that such smaller but better located and user-oriented systems are far better performance-wise. In fact, the benefit is so big that the increase of the complexity of the whole system is acceptable. Most of the technologies used today are:
  + **Relational Data Base Management Systems(RDBMS) –** This primal technology is still a backbone of many small to medium systems. Data is stored in strictly defined tables which put a lot of restrictions on you but keep everything nice and clean. RDBMS’s let you keep your data well organized at the cost of size limitations.
  + **NoSQL –** Gaining great popularity recently as its unorthodox approach to data storage finds its usage in the ever developing BI. The big ideas here it to not put coming data intro standardized tables but store it as it comes in for example JSON format. This fundamental change opens a new world of possibilities. Significant speed boost of operations done on the data is observed as well as easy of splitting the data upon many storage clusters. The cost is lack of integrity. There are many different implementations of NoSQL databases, for example: Graph, Document, Key-value. Each coming with its own powers and weaknesses. Curious reader is redirected to more insightful literature such as (Fowler, 2012)
  + **Distributed Storage –** Another layer of complexity faced by BI on everyday basis is the process of manipulating the stored data. After receiving it from ETL and before sending it to more elaborate processing the data has to be, simply put, gathered from all of the data storages. The challenge grows more and more as the data accumulates and with it devices used for storing it. One good example of software solving that problem is Apache’s Hadoop (Hadoop).The framework provides HDFS (Hadoop Distributed File System) which targets the problem of multiple data storages or MapReduce which helps manipulate the stored data. It is worth mention that the area of distributed storage is still super fresh and new groundbreaking ideas are presented every month.
* **Data analysis –** Havingacquired a reliable source of data we can start ripping fruits of our labor. This part of BI technology stack is certainly the most diversified one. Every company has its own business environment and human capital which results in a multitude of possible data analysis methods. For example, Sera (Sera, 2014) notes that it is a standard practice to use Excel for BI tasks among some companies.

I would like to enumerate some of the technologies which emerged thanks to BI and are successfully used in industry.

* **OLAP (Online Analytical Processing) –** Defined as “*OLAP performs multidimensional analysis of business data and provides the capability for complex calculations, trend analysis, and sophisticated data modeling.”* (olap.com). Technique using OLAP cubes which let you quickly acquire very specific reports within short time-span. For example, a Head-Statistician could acquire a quick glimpse into the possible Pricing strategies of his company.
* **Dashboards –** Generally, one-page long document containing all of the most important information presented in the most intuitive manner. It should be possible to generate such document within seconds and the data presented should be always up to data. Simply put, reporting at its finest.

How is it possible that BI influenced something so logical and trivial? International corporations spend months gathering all of the important data and putting it together but BI lets us automatize this process and achieve even better results within seconds.

Widely used products are for example Microsoft’s Power BI (PowerBI) or Tableau’s Tableau (Tableau).

* **Machine Learning –** One of the hottest terms of the current decade. Mixture of data exploration, statistics, computer science or optimization theory. Many have already given up trying to come up with a definition for this term. What it consists of are techniques such as neural networks, decision trees, support vector machines, Bayesian statistics, genetic algorithms and many more all of which let us create small AIs. Those are then used to help us make decisions, predict future or automatize cognitive tasks.

All of ML algorithms have one type of fuel. That is data, which BI has more than enough. This way both BI and ML flourish and cooperate in synergy increasing profits and nearing the AI world overtake.

Industry-wise it is worth mention of services like IBM Watson (WatsonIBM) which are platforms with AIs ready to perform tasks for our company.

## Business examples of Success and Failure.

**Success** stemming from usage of BI can take many forms. I would like to present a Case Study of Bank of India (Ramco, 2010). The institution took upon itself a challenge of implementing a Corporate Performance Management System. The system would allow to gain full insight into their portfolios across the most important product lines. The challenge was exposed to strict requirement. The system was to be completed in 24 weeks. Almost unimaginably small span of time when compared to industry standard of 2 years.

As to comply with the requirements it was decided that a pre-built system ought to be implemented. External company “Ramco”, which specializes in this area, was employed to install their solutions. Ramco provided Bank of India with proprietary software such as Ramco Banking Analytics software, pre-built Data Warehouse called the Universal Database and many more. Additionally, training of Bank’s personnel was delivered.

Professional approach and well-made software made it possible for Ramco to fulfill the full contract within the time span. Effective and short training session let the new system be easily implemented and immediately started being used.

The whole investment was a major victory for the Bank of India. Among the numerous advantages achieved the most important were:

* A 360° view of loans, deposits, trade finance, customer portfolio as well as financial profitability of the bank rendered possible through analyses across several attributes.
* Comprehensive customer analysis and profitability analysis of various business lines and business units.
* ‘Single version of truth’ by elimination of ambiguity arising from several versions of management reporting data.
* Effective and transparent performance reviews.

**Failure** even tough bitter in taste has to be taken notice of and learned from. Such opportunity is given to us by Portland State University (PSU) (Blanton, 2012). The institution had to finally face the change of times and upgrade its reporting system, which until this time consisted mostly of random spreadsheets. PSU launched a DataMASTER program (Management and Analytics for Strategic, Timely, Education Reporting). The investment was supposed to bring a plentiful of improvements. Those were:

1. Enterprise-wide systems that effectively support the university

* Improving and integrating related processes
* Eliminating shadow systems, paper, and duplicate data entry
* Clarifying roles and providing expanded training
* Simplifying and standardizing processes

All of those benefits were supposed to overall cut costs.

PSU took upon itself a challenge of developing the whole system by itself. They did not opt for a pre-made solution as they believed their approach had to succeed. The program was lead by an IT team, which made great efforts towards planning the whole development process. That involved being very transparent about the work they do, having very flexible plan, cooperating heavily with other departments and having a user-centric approach.

Unfortunately, the program did not achieve its goals. After two years of heavy work the DataMASTER was still not sufficient to replace the legacy systems. The parts developed also did not bring any increase of productivity or decrease in costs.

There were many problems, the ones showed here are in my opinion the most thought-provoking ones. More curious reader is redirected to the source article.

1. Project was run entirely by an IT group – Solution of an importance spanning the whole organization can not be isolated to only one department. In this case, the assignment of the whole project to just the developers made it impossible to acquire an adequate involvement of other departments.
2. **Project management must adjust to the customers involved – The case of PSU is an excellent one because it underlines the dislike towards change even with it being certainly positive. The university had to undergo a relatively quick switch from a decentralized world of self-controlled processes to a centralized one with every action monitored and integrated into the greater whole. Such disruptions are especially hard in uncreative organizations, such as administration of a college.**
3. The leader should be person rooted in the environment – One of the biggest factors which lead towards the goal not being achieved, in PSU’s case, was appointment of a totally fresh Project Manager. Person with no background in the organization could not have possibly successfully implemented solutions for problems sitting deep in the institution.

**Summarizing,** implementing BI is a feat well-worth its bad fame. With around 70% of BI adoptions being unsuccessful the head of the organization has reasons to doubt whether it is worth the trouble. The answer is clearly YES but it is vital for special risk measures to be taken during planning of such project.

# Intelligent Business with examples of technology stacks

## Reporting

**Every type of a manager** encounters one peculiar problem during his normal day of work. Whether he is preparing a new strategy for his swiftly developing company or trying to find a leak quickly emptying organization’s treasury there exists a demand for quick, intuitive and comprehensible document granting insight into all of the most important business-related indicators.

Depending on the size of the company the document could take form of one spreadsheet with two simple graphs or a 100-page long monstrosity. What helps us create this document and make it as simple and informative as possible are the BI technologies centered around reporting.

The idea is very simple. You take your preprocessed data and put it into software which knows how to display it in the best way. Typical technology stack would look like this.

1. **ETL (Extract, Transform, Load) tools -**
2. **Data Warehouse – ERP**
3. **OLAP or ad-hoc query**
4. **Dashboards -**

## Prediction

**Foreseeing future is a dream of many.** Unfortunately, it is impossible as far as human beings are concerned. There are tricks though that let us get really close. Statistics, Computer Science and Economics are the sorcerers allowing use to see into a magic orb. But their power comes from data which they need a lot of.

Modern BI systems let us use a really huge part of the weaponry offered by the aforementioned sciences with just a few clicks of buttons. That means even a person without any academical background is able to create his own models and predictions. The reader should be ware that it is still not advised to sack his human analyst with a good dose of experience behind his back. No matter how easy to use they are the models will always have to be interpreted and no machine can really understand the business environment. The other argument being that such tools can be of good use to normal worker but a person with a Ph. D. in Statistics will be always able to achieve better results.

The technology stack in this case undergoes minor changes:

1. **ETL (Extract, Transform, Load) tools -**
2. **Data Warehouse –**
3. **Massive data consumption**
4. **Neural Networks and stuff -** 
   1. Performance Management

In his book ‘’Performance Management Revolution” (Dresner, 2007) compares an ERP system used by a plentiful of companies to a football scoreboard. Even tough perfect for stating who the current top star is it does not give you any other information. It will not help you discover your weak sides or ways for upgrading your performance.

The solution for this problem, stated by Dresner, is an EPM (Enterprise Performance Management). EPM is a system allowing the organization to go one step further than simple reporting. New technologies let managers use the information gained during reporting by quick communication of the problem and dispatch of resources. Two examples given by Dresner are:

* Manager of a chain of hotels discovers misuse of resources in one of the locations. In a typical case the manager would have to communicate directly of indirectly with the head of the location than communicate the issue and finally hope for a quick resolution of the issue. EPM would allow for a quick flagging of the problem which would be directly sent to the person responsible. Great dose of time waste and risks is being reduced.
* Newest report shows the poor state of a particular product in terms of sales. EPM suggests possible solutions and show possible paths of implementation.

According to the newest reviews the typical technology stack would look like this:

1. **Data source –**
2. **Data store –**
3. **Data fetch –**
4. **Data usage -**

## Identyfing possibilities

# The future is intelligent

## The hidden potential

## The development of technology

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