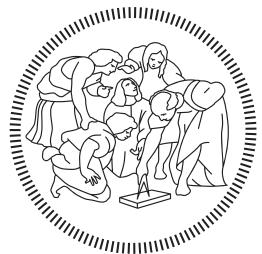


Business Information Systems - Part 2
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Workforce Management Lecture

Agenda

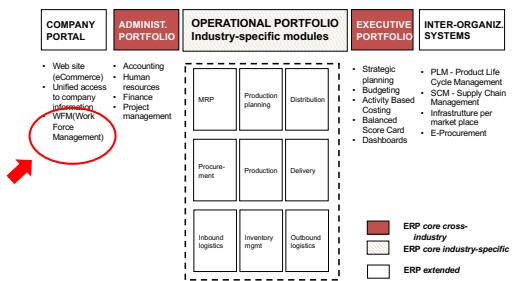
- Functionalities and technology architecture of WFM
- Case study: OTIS elevators
- Case study: Utility company



Extended ERP and Workforce Management

Now, let's move on to the topic of workforce management. Extended ERP is the focus here. Extended ERP aims to integrate all information flows and processes involving not only internal actors like employees but also external players such as clients and partners of the company. This comprehensive approach ensures efficient interactions between the company and its stakeholders.

Functional architecture of ERP systems: overview



Client Relationships and Transaction Models

Workforce management is closely tied to the relationship between a company and its clients, particularly during the post-sale phase. This relationship is governed by a transaction model, which we discussed in the context of transaction theory. It's important to note that there are various types of transactions, depending on the nature of the goods or services involved. However, all transactions ideally consist of four phases, with the final phase being post-settlement or post-sale services. Workforce management focuses on these post-sale services and the ongoing relationship between the company and the client.

Post-Sale Services and WFM in Manufacturing

When discussing workforce management, it is often in the context of the manufacturing industry. In this industry, companies produce physical products that are installed at the customer's location. Examples of these installations include elevators, household appliances like washing machines and dishwashers, as well as appliances for electricity or gas. The focus of workforce management in this context is on maintaining these installations.

Once a customer has purchased an appliance, they may encounter issues that require maintenance. The manufacturer is responsible for addressing these maintenance requests. Typically, the customer has already paid for the appliance, so the transaction has been completed. However, additional services are needed to resolve any issues with the product. To provide these services, the company must send specialized employees to the customer's location.

Maintenance Challenges and Costs

For example, let's say your elevator is broken. In this scenario, someone from the company needs to come to your building to fix it. However, having a workforce that needs to travel to different locations comes with a significant cost for the company. It would be much more cost-effective if the client could bring the appliance to the company for repairs.

To illustrate this, let's consider the example of a broken cell phone. When your cell phone breaks, you don't have someone come to your place to fix it. Instead, you go to a shop that specializes in cell phone repairs. You might go to a shop in Chinatown, for example, where they provide excellent service. You drop off your phone, go about your day, and then return to pick it up once it's fixed. This process requires you to invest your time in physically going to the shop, which can be a significant amount of time. However, you are not charged for the traveling costs.

In contrast, when a company needs to send a workforce to your home to fix a broken appliance, it becomes more complex. The company has to consider the costs associated with sending their workforce to your location, including travel expenses and the time required for travel. These costs are eventually factored into the price of the service, which you, as the client, will have to pay. Unlike when you take your cell phone to a shop, where you are not charged for traveling costs, the company needs to include these costs in their service fees. Additionally, the company must ensure that they send the right skilled workers to address the specific issue you are facing.

Emergency vs. Routine Maintenance

What is WFM?

- Target: post-sale services
- Work force: employees with technical skills who are in charge of maintenance processes
- Maintenance:
 - Routine maintenance: it is scheduled by the company and represents a profitable service.
 - Emergency maintenance: it is asynchronous and must be scheduled, executed, and billed according to the characteristics of each individual maintenance request.
- Both types of maintenance typically involve a physical maintenance activity on the product/plant at the customer's site

And so, when it comes to fixing appliances like elevators, the team responsible for the repairs needs to have the necessary skills and competencies. Unlike other appliances that can be taken to the company for repairs, elevators need to be fixed on-site, which often requires multiple visits. The first visit is to assess the problem, and subsequent visits are made with the appropriate team and materials to fix the issue. This process is complex and involves managing response times, which is crucial for customer satisfaction and safety.

In the case of elevators, response time is particularly important because a malfunctioning elevator can pose a safety risk, especially if someone is trapped inside. For example, if a patient in a hospital is being transferred between departments and the elevator gets stuck, it becomes a matter of urgency to rescue them. The level of service provided in these situations is not only important for customer satisfaction but also for ensuring safety. Incidents where people are trapped in elevators and their lives are at risk are rare but significant. Therefore, the level of service and efficiency in handling emergencies is crucial.

Maintenance plays a vital role in assessing the quality of service provided by a company. When an appliance breaks down, it is an opportunity for the company to demonstrate its commitment to customer satisfaction. If the company efficiently handles the maintenance process, customers are more likely to remain loyal. Studies have shown that satisfied customers who receive efficient maintenance services are more likely to continue purchasing products from the same company. Acquiring new customers is challenging, so maintaining the loyalty of existing customers is essential for long-term competitiveness.

Elevators are a prime example of the importance of maintenance because they are long-lasting investments. Instead of replacing a broken elevator, it is more cost-effective to repair it. Therefore, maintenance becomes even more critical for elevators. However, maintenance requests can be divided into two types: routine maintenance and emergency maintenance. Routine maintenance, such as changing the oil in a car engine, can be planned and scheduled in advance. It is preventive maintenance that helps avoid breakdowns and can be optimized for efficiency. On the other hand, emergency maintenance is unpredictable and requires immediate attention.

Is maintenance profitable?

- Routine maintenance is profitable (particularly, the sale of spare parts)
- Emergency maintenance is often non profitable.
- Without an ERP, the typical situation is that overall maintenance (routine + emergency) is a cost center instead of a profit center.

Routine maintenance is relatively easy to manage and profitable for companies. It can be planned ahead of time, and the effort required is known in advance. This type of maintenance is designed to be straightforward and can be performed without specialized expertise or spare parts. It is a predictable demand that allows companies to allocate resources efficiently. In contrast, emergency maintenance is unpredictable and requires a reactive response.

In summary, the composition of the workforce and their competencies are crucial for fixing appliances like elevators. Response time is essential for customer satisfaction and safety, especially in emergency situations. Maintenance is an opportunity for companies to demonstrate their commitment to customer service and build loyalty. Routine maintenance can be planned and optimized, while emergency maintenance requires immediate attention. By understanding the different types of maintenance and their importance, companies can ensure long-term competitiveness and customer satisfaction.

Customer Service and Maintenance Requests

In the case of sudden problems that require management, the typical scenario involves a client calling the company to report the issue. This asynchronous communication requires a synchronous response from the company to handle the problem efficiently. However, this type of demand is difficult to forecast, leading to challenges in planning and efficiency. Emergency maintenance, especially if it involves safety, must be prioritized regardless of location. This means that companies must be prepared to serve clients in remote areas, even if it is less convenient or profitable.

Outsourcing maintenance?

- Why non proprietary maintenance services?
 - The sale of spare parts can be used as an economic lever. If price is high, non-original spare parts are available on the market.
 - The physical distribution of customers gives an edge to local maintenance services.
 - In general, smaller companies are more flexible and can accommodate maintenance with greater efficiency.
- In some cases, companies partner with non proprietary maintenance services to outsource maintenance.
- Outsourcing maintenance can be risky:
 - Non-effective maintenance has a negative impact on the company's brand equity.
 - Legal issues/liability for inefficient emergency management.
 - No cross-selling.

For manufacturing companies, the transaction with the customer typically ends with the payment, and there is no ongoing contract or relationship. This can lead some clients, especially businesses, to seek mainte-

nance services from other providers instead of the manufacturer. This is often driven by the perception that independent maintenance services are cheaper than going to the manufacturer. Smaller maintenance services tend to focus on profitable areas with high concentrations of potential issues, while leaving less profitable areas to the manufacturer. As a result, manufacturers are left with the more challenging and less profitable emergency maintenance tasks.

Why is maintenance costly?

- Customers (and the workforce) are physically distributed over a (possibly) large geographical region.
- Visits are costly.
- Maintenance activities can involve different skills. The optimization of teams, schedule, and visits is not an easy task.
- A maintenance request is often generic and multiple visits are needed to specify customers' needs.
- Spare parts may or may not be available, especially for emergency maintenance.
- SLA can be tight. If human life is involved, companies must oversize their workforce (e.g. elevators).

Emergency maintenance is generally not profitable, especially when it requires sending a workforce to the customer's location. Maintenance activities can be costly due to the geographical distribution of customers, the expense of visits, and the difficulty of finding employees who are skilled at problem-solving. Employees who excel at fixing appliances may even leave to start their own maintenance services, becoming competitors to the manufacturer. Additionally, handling maintenance requests can be challenging, as customers often express their frustration and anger without providing essential information about the appliance and its model.

Overall, routine maintenance is typically more profitable than emergency maintenance. However, the nature of emergency maintenance, with its generic and often emotionally charged requests, makes it more difficult to manage efficiently.

Optimizing the Maintenance Process

To optimize the maintenance process, it is important for customers to provide essential information about the appliance, such as its location and details. However, many customers are not aware of this and may struggle to accurately describe the problem. This is where the call center operators play a crucial role in asking the right questions to gather the necessary information. Unfortunately, level one call center operators often lack the skills to ask precise questions, which can lead to inefficiencies in the process.

To address this issue, it is important for organizations to ensure that the call center operators have access to an enterprise resource planning (ERP) system. This system can help them set up appointments and share the workforce's agenda, ensuring that the right resources are available when needed. Additionally, having spare parts readily available is essential

The worst maintenance process (no ERP)



- Reworks: inbound and outbound contacts
- No intelligent Q&A in first call
- Multiple visits (no spare part in truck, team skills are not adequate to customer problem)
- Internal coordination with workforce team members
- Errors in invoice
- No cross selling
- No KM

to avoid delays in the maintenance process. However, tight service level agreements (SLAs) can pose challenges, as the workforce needs to be adequately sized to handle peak calls, which can increase costs.

Maintenance is a service

- Maintenance should be seen as a service that has an impact on customer loyalty.
- Maintenance becomes profitable if we account for the positive impact on customer loyalty (reduction of customer turnover).
- Customer loyalty is not easy to achieve.
- Customer loyalty is tied to emergency maintenance more than it is to routine maintenance.
- Customers may decide not to buy an ordinary maintenance service, but need an emergency maintenance service anyway.

It is common for maintenance to be seen as a non-profitable and challenging process. However, it is crucial to change this mindset and view maintenance as a service that can help build customer loyalty. Outsourcing maintenance may seem like a good solution, but it can have negative repercussions on brand equity if issues arise. Therefore, organizations should carefully consider the level of service provided by maintenance service providers before outsourcing.

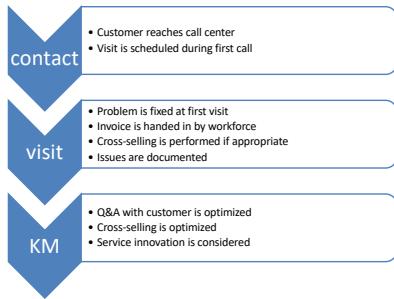
The worst possible maintenance process is one where the customer provides limited information about the issue, leading to multiple visits and coordination challenges within the workforce. This not only inconveniences the customer but also increases costs. Additionally, missed opportunities for cross-selling¹ can occur during maintenance interventions. This is the perfect time to offer maintenance subscriptions or additional services to customers.

To optimize the maintenance process, it is crucial for call center operators to ask the right questions and gather accurate information from customers. This will help streamline the process, reduce costs, and improve customer satisfaction.

¹Cross-selling is a sales strategy where a company encourages customers to purchase additional products or services related to their initial purchase. The goal of cross-selling is to increase the average transaction value and maximize revenue from each customer. This strategy involves suggesting complementary or supplementary items that go hand-in-hand with the customer's original purchase, thereby enhancing their overall experience and meeting more of their needs.

Knowledge Management and Business Intelligence

The ideal maintenance process



To ensure efficient maintenance processes, it is important to have an intelligent Q&A system in place. This system allows the maintenance workforce to diagnose problems accurately and quickly. By diagnosing the problem, the necessary spare parts can be prepared in advance. The ERP system can be used to check if the spare parts are available in the physical warehouse and ensure they are loaded onto the truck. This way, the technician can make an appointment at the right time and avoid any delays.

Invoicing is another crucial aspect of the maintenance process. It is essential to make the customer aware of why they are spending money and provide a breakdown of the costs, including the price of the spare parts. By doing this, the customer can understand the value they are receiving for their investment. It is recommended to print the invoice as soon as possible, preferably during the discussion with the customer, to ensure accuracy and transparency.

Training the workforce to handle the administrative part of the job is necessary. Although technicians may not enjoy administrative tasks, it is important to equip them with the skills to handle invoicing and other administrative responsibilities. This can be facilitated by using a simple application that tracks materials used during maintenance services and simplifies the invoicing process.

Key actions towards the ideal process

- Implement a KM process:
 - Ask questions during first contact to describe the nature of the maintenance issue
 - Involve workforce in KM process
 - Create editors of new knowledge on maintenance processes provided by workforce
 - Cluster maintenance issues and relate to skills of workforce
- Implement embedded technologies to help prevent emergency maintenance through targeted routine maintenance
- Redesign maintenance process by considering truck as a warehouse of spare parts replenished with JIT logic
- Generate invoices automatically

Implementing knowledge management is crucial for an intelligent Q&A system. By analyzing past maintenance interventions and building diagnostic intelligence, the system can ask the right questions and provide accurate solutions. Additionally, appliances equipped with sensors can self-diagnose and provide

error codes, making the Q&A process even more efficient.

Furthermore, by analyzing data from maintenance services, companies can gain valuable insights into common issues with different appliance models. This information can be used to improve product design and solve recurring problems. However, it is important to note that using knowledge management to intentionally shorten the lifespan of appliances for profit is unethical and should not be practiced.

In summary, the key actions to achieve an ideal maintenance process include implementing knowledge management, using an intelligent Q&A system, training the workforce in administrative tasks, and analyzing data for continuous improvement.

Case Studies

OTIS Elevators Example

Knowledge management is essential for analyzing data and understanding maintenance issues. By collaborating with the maintenance team and Research and Development (R&D) team, you can identify and fix problems before they become emergencies. This not only helps avoid costly interventions but also allows for the transformation of emergency maintenance into routine profitable maintenance. By analyzing information on maintenance interventions and working with R&D, you can discover the most common and recurring issues and implement preventive maintenance to avoid emergencies. This knowledge can be kept confidential and used to offer a competitive service in the market.

OTIS elevators: the starting point

- OTIS is a global leading company in its sector
- It has not outsourced maintenance, as it has been always perceived as key to the brand
- Maintenance is:
 - Challenging, since safety is involved
 - Interesting since the life of the product is particularly long and demand is a steady variable
- The strategy of OTIS is to sell the maintenance contract together with the product to get as many subscriptions as possible before competitors come in

OTIS elevators: the management issue

- They experienced a decrease in market share (maintenance market)
- The decrease was faster in urban areas where smaller competitors provided maintenance services at a lower price.
- Urban areas are the most profitable areas for maintenance services and decreasing price would significantly reduce profitability.
- OTIS applied higher prices also due to high internal costs, therefore lowering prices to a competitive level would make OTIS maintenance processes non-profitable.

A case study that exemplifies these issues is the OTIS Elevator company. They faced the challenge of unprofitable maintenance services due to competition. Competitors focused on the easiest and most profitable interventions in urban areas, leaving OTIS Elevator with elevators in remote areas that lacked maintenance subscriptions and routine maintenance. This resulted

in numerous emergency calls. Additionally, OTIS Elevator mismanaged interventions and faced payment issues from clients. While a small percentage of unpaid interventions can be managed, if it grows, it becomes a problem as it affects the profitability of the maintenance processes.

OTIS elevators: the solution



- They implemented KM
- They redesigned their maintenance processes
- Their goal was cost reduction, but they continued to sell their service as leading service as opposed to low cost solutions
- They implemented embedded technologies and reduced the need of emergency maintenance by over 30%.
- Their leveraged their position as large global company to provide a highly responsive call center service (OTISLINE communication service).
- With mobile devices, the workforce has real time access to technical and administrative information

To address these challenges, OTIS Elevator decided to change their maintenance processes and implement knowledge management. This involved conducting proper business intelligence analysis and data analytics to uncover the root causes of issues and their relationships. By working with data scientists and R&D, they established routine maintenance interventions that reduced the need for emergency interventions. They also leveraged their ability to diagnose issues before they occur and offered highly competitive prices for their maintenance services.

By understanding the issues and their causes, OTIS Elevator was able to proactively replace parts after three years, resulting in cost savings for customers and the ability to offer maintenance interventions at a discounted price compared to the market. Through this process, they invested in customer relationships and subscription maintenance services, reducing the need for emergency maintenance by 30 percent and becoming more competitive in terms of pricing. This demonstrates the benefits of industrializing processes by standardizing and making them more efficient.

By utilizing knowledge management and business intelligence, OTIS Elevator was able to act proactively and avoid problems. This approach not only improved their maintenance processes but also enhanced their overall service quality.

OTIS elevators: the solution



"Otis offers a variety of maintenance programs and building support systems to fit customers' needs and equipment types. We have standardized work practices around the world and can tailor a maintenance program specifically to the environment. Ultimately, the right maintenance at the right time extends the life of the equipment and protects the owner's investment."

And then they implemented an industrialized process. The value proposition became subscribing to their maintenance service, which would result in a 30

percent reduction in emergency maintenance interventions and cost savings for customers. This would also improve the quality of their lives by minimizing the need to handle emergencies. By offering this service, they could shift the blame to competitors if any issues arose due to improper routine maintenance. In business contexts, people are willing to pay to avoid problems, making this a strong value proposition.

OTIS elevators: the solution



Otis developed the REM (Remote Elevator Monitoring) system to optimize elevator performance and minimize elevator downtime. It is a sophisticated interconnected system of sensors, monitors, circuits, hardware and software to collect, record, analyze and communicate data about elevator operations 24/7. If the REM system detects a problem, it analyzes and diagnoses the cause and location, then makes the service call and helps an Otis mechanic identify the component causing the problem. Elevators are often back in service before owners or tenants even know there is a problem.

They successfully sold many maintenance services by investing in IoT and offering free sensors and diagnostic tools for old elevators. This allowed them to send the right technicians with the necessary spare parts at the right time. Ultimately, their solution extended the lifespan of the equipment and protected the owner's investment. They positioned maintenance as a service rather than a costly and unprofitable process.

OTIS elevators: the solution



The Web-based EMS Panorama system enables building staff to monitor, control, report on and manage a full range of operation-critical functions from any computer with an Internet connection. Users can monitor the status of up to 30 groups of elevators, escalators and moving walkways, looking at a single building or an entire airport, college campus or medical center. Because the EMS Panorama system offers comprehensive, real-time data that shows building managers the full picture, they are able to respond quickly to passengers' needs and make informed decisions about equipment operations with greater certainty than ever before.

Their web-based system included remote monitoring capabilities, allowing them to proactively address issues before they occurred. They would contact customers to schedule maintenance visits, creating a high level of trust and customer satisfaction. This approach allowed them to charge premium prices, similar to a luxury hotel experience.

OTIS elevators: final considerations

- It does not look as a low-cost maintenance service....
-it looks as a high-quality service that aims at customer loyalty.
- They have reduced internal costs by improving coordination.

Utility Company and Smart Meters

Let's discuss the use of intelligent meters by utility companies. These meters provide real-time information on consumption, allowing for accurate billing without the need for manual readings. Instead of sending a workforce to check the meters, utility companies can position intelligent meters that provide consumption data in real time. This eliminates the need for manual

WFM in a utility company (power supply)

- In utility companies, WFM is tightly related to back-office legacy functionalities:
 - Billing: it includes all accounting functionalities. Billing is usually periodical and includes the cost of maintenance (both routine and emergency)
 - Scheduling of workforce activities is usually one for both installations and maintenance.
- Maintenance is often requested by multiple customers (e.g. blackout)
- Maintenance and general inquiries go to the same call center

readings and reduces costs.

Smart metering



- Remote access to energy consumption information (in real time)
- Alerts and alarms
- Self diagnosis
- Remote controls (on-off, limit to energy consumption, ...)

However, utility companies have not fully utilized the potential of the information provided by these meters. Currently, they mainly use the data for self-diagnosis and fixing any issues with the meters. While this is useful, it does not offer a compelling value proposition to customers. The meters themselves are simple and do not require frequent maintenance like elevators, so the potential for additional services is limited.

The value proposition of these meters is primarily focused on improving invoicing accuracy. However, utility companies are now reconsidering their approach due to sustainability concerns and the increasing cost of energy. They are exploring the idea of using renewable energy sources and optimizing energy consumption to reduce costs. This could potentially create a more compelling value proposition for customers.

In conclusion, while utility companies have not fully capitalized on the potential of intelligent meters, there is ongoing exploration of new value propositions. The example of the OTIS elevator remains a favorite case study, highlighting the importance of integrating maintenance into the overall service cycle.

KPMG on ERP Systems

Introduction and Agenda

KPMG Agenda

1. From Legacy systems to ERP systems (historical evolution)
2. How ERP systems are made (levels, environment)
3. The introduction of an ERP system in the company
4. SAP: sample of ERP system
5. ERP Projects

We have plenty of time this morning, so let's make the most of it. I propose structuring the next 60 minutes as follows:

First, I will provide a brief introduction about myself and the company I work for. Then, we will dive into the documentation I have prepared.

To begin, my name is Marco Trammelli, and I am a senior manager of advisory at the KPMG company. I will give you an overview of the system we will be discussing today, which serves as a prerequisite for understanding the rest of the session.

Next, we will move on to the second part of today's session, where I will introduce a test case scenario that you will be working on in the coming days. After that, I will hand over the stage to my colleague from the HR department.

System Overview

Historical Perspective and Evolution

Let's start with a brief introduction to the system, considering its historical perspective and evolution. We'll also provide an overview of a sample system, the SAP ERP system, which is widely used in the market. If time permits, we'll then move on to our recommendations for implementation and development projects.

From Legacy systems to ERP systems What Legacy systems are

- They are created as successive layers of autonomous applications, each of which covers the IT needs of different organizational units.
- Each Legacy application has its own Database
- They can be connected to each other through interfaces.
- They are developed in a "custom" way, i.e. they are built through an extensive use of software programming activities.
- They are technologically underdeveloped and therefore based on Mainframe or Host technologies and characterized by character-based interface.
- They are not always characterized from relational Data Base.

The term "legacy system" refers to a collection of

autonomous applications, each with its own database. These systems are not interconnected, and interfaces need to be developed and implemented to establish communication between them. In the following roadmap, we'll highlight the evolution of these systems over the decades, starting from the first enterprise resource planning system in the 1970s.

Legacy Systems vs. ERP Systems

From Legacy systems to ERP systems

Legacy and the evolution from MRP to ERP

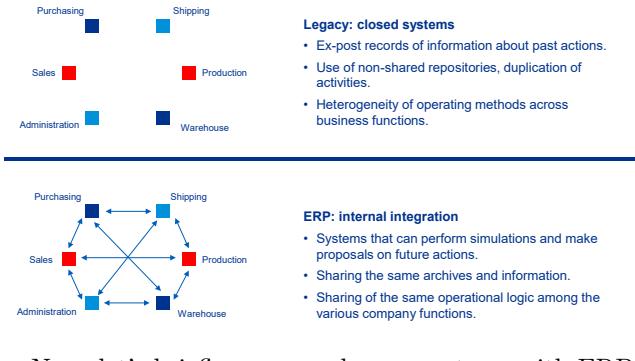
Legacy systems are softwares usually developed in-house which allow the registration of all the operational activities of the corporate functions.



Basically, this system was initially developed for manufacturing and production processes within the organization. Over time, additional features were added to support other functions and processes. This evolution led to what we now call the extended ERP system.

From Legacy systems to ERP systems

Legacy System vs ERP (1/2)

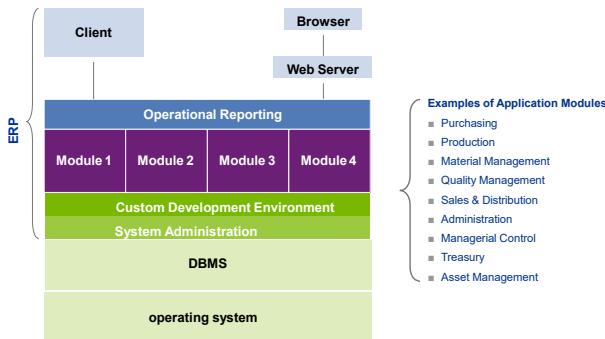


Now, let's briefly compare legacy systems with ERP systems. Legacy systems are often referred to as closed systems. They store information about past actions in their own databases. Each function in the organization, such as purchasing, shipping, production, warehouse administration, and sales, typically has its own separate system. This lack of a common repository can lead to duplicated activities and operational inconsistencies across different business functions.

On the other hand, the ERP system is a unique system that can simulate and propose future scenarios instead of focusing on the past. This system shares a common database, which I will refer to as a table or database. Additionally, there is a sharing of operational logic among different functional areas within a

How ERP systems are made (levels, environment)

The logical architecture of an ERP system



company, such as purchasing, shipping, and production. Each block in this diagram represents a specific function within the organization. It is important to note the close interconnection of activities carried out in these functional areas. Instead of developing separate programs for each function, the system allows for the development of shared programs for multiple functions. These key features cover various business processes, including logistics, accounting, production, and human resources. These processes are supported by a set of application elements known as modules. Throughout this presentation, we will explore how each module represents a specific function within the organization.

How ERP systems are made (levels, environment)

Legacy systems VS ERP systems

Legacy Systems	ERP Systems
<ul style="list-style-type: none"> Organization by Functions Software that grows with the company, adapting to it and its needs Often the result for the company is a set of modules distributed in different hardware/software environments and not perfectly integrated They are difficult to open to the external environment They serve in some cases in order to develop and to conserve the business know how The expansion of the perimeter of the business (geographically, new businesses, new processes) 	<ul style="list-style-type: none"> Process Organization Software that is created by incorporating Best Practices They allow the strategic development of companies High degree of integration: a single hardware system and a single database Require companies to seek an alignment towards the best practices of the system Reduce the risk of dependence on developers' know-how

Can someone explain what a legacy system is and what the main differences are between a legacy system and an ERP system? Let's imagine a company and focus on the purchase processes, such as purchase requisitions, purchase orders, receiving invoices, etc. Invoicing is related to accounting and finance, while purchasing is mainly related to the buyer or someone in the purchasing department. It's not interesting to discuss the connection between finance and accounting in these processes. A legacy system uses different tables that need to be reconciled, requiring the implementation of multiple interfaces and effort to check for redundant data. On the other hand, an ERP system has a common structure with a unique table, eliminating the need for reconciliation and interfaces. By implementing an ERP system from the beginning, an

organization can focus on developing efficiency in processes instead of spending time and money on reconciling data. Legacy systems are difficult to integrate with external tools, while ERP systems already have connections in place. ERP systems also come with embedded best practices for accounting, finance, and purchasing processes, making them ready to use with just configuration based on the organization's specificity. Legacy systems require specific interfaces to integrate with other software and require the organization to align with best practices. If a specific process is not in line with best practices, it cannot be included in an ERP system without revising and adapting it. When selecting an ERP system, industry specificity, specific organizational issues, business strategy, industrial development plans, processes, and resources should be considered. These factors will guide the software selection process, whether it involves implementing an ERP system from the market or looking for specific software applications from local vendors.

ERP Implementation and Development

How ERP systems are made (levels, environment)

ERP systems features

- They cover the **main business processes** (logistics, accounting, production, human resources) through a set of application elements called "modules" or "granules";
- They guarantee the **uniqueness of the data** and therefore the unicity of business information, thanks to the fact that transactions update online the data managed by all business functions;
- They are produced by the **major software houses** that develop them according to the requirements of pilot customers and update them continuously according to technological, regulatory or best practice evolutions;
- Controlled data management** and **uniqueness** imply that data cannot be modified directly but through "transfers";
- They are characterized by **relational DB**;
- They are characterized by a **Client/Server architecture**;
- Although they do not cover all Core Business processes, **vertical solutions by industry** are available for the main ERPs;
- They bring into the company a set of processes referred to best practices, without having to "reinvent the wheel".

The logistics department, accounting, production, sales, and human resources all benefit from the adoption of an ERP system. By sharing the same repository and database, businesses can ensure the uniqueness and universality of their data and business information. Major software vendors like Microsoft and SAP produce and release ERP systems, such as MRP (Material Requirements Planning).

From a technical perspective, ERP systems use a relational database and operate on a client-server architecture. They also offer vertical solutions tailored to specific industries, such as automotive or healthcare, which have unique business processes and requirements.

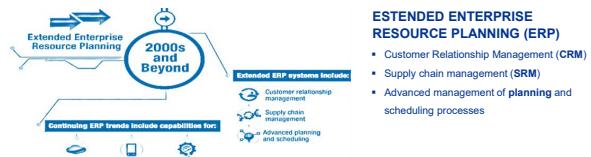
Implementing an ERP system allows companies to leverage best practices and standardized processes across departments, eliminating the need to reinvent the wheel for each company. This saves time and resources while ensuring efficiency and consistency.

Moving forward, many companies are already using ERP systems like Microsoft or SAP, but they continue

to seek improvements and enhancements to their systems.

Future Directions and Cloud Computing

How ERP systems are made (levels, environment) The present and the future... (1/2)



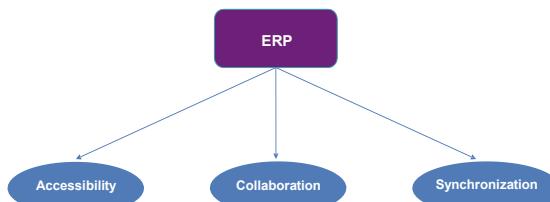
The new ERP platforms are developed consistent with current paradigms regarding:

- Cloud Computing
- Remote usability Mobility
- Leveraging the processing capabilities of large volumes of data Analytics (Process Mining)
- Extension of the Internet to the world of concrete objects and places (IOT Internet of Things)

In recent years, there have been common words and concepts that have gained popularity, such as cloud computing and mobility. As a consulting firm, our clients are increasingly requesting these features to enhance their processes and handle larger volumes of data. This includes leveraging analytics and exploring the Internet of Things.

How ERP systems are made (levels, environment) ERP systems evolution: Extended ERP (1/3)

The main evolutionary line of the ERP systems is that one to open itself towards the outside supporting models of company "extended" or virtual.



These are the keywords that define the evolution of the market: accessibility, collaboration, and synchronization are the driving forces behind this shift. One of the leading software vendors in this field is SAP, an international company that has been instrumental in shaping this framework. Until about five years ago, most companies were developing and implementing their systems on-premise. This meant that they purchased licenses and installed the software on their own servers.

Nowadays, many vendors, including SAP, are adopting a philosophy of moving everything to the cloud. This means that companies looking to implement SAP solutions no longer need to install them on their own servers. Instead, everything is accessible through the cloud. The core business processes, such as finance and accounting, can still be kept on-premises using the core ERP system. However, specific processes, like purchasing, can be linked to dedicated cloud solutions.

For instance, consider the purchasing processes of creating a purchase request, issuing a purchase order, and receiving goods. These processes can be efficiently managed using a dedicated cloud solution called Ariba², which is tightly integrated with the core ERP system. This is the direction the market is moving towards, and it is important to consider this when making a business case.

In summary, the trend is to move towards cloud-based solutions, with core processes remaining on-premises and specific processes being managed through dedicated cloud solutions.

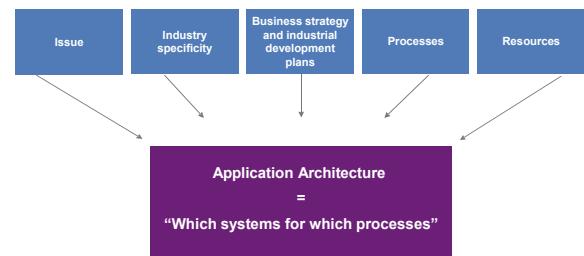
Integration Challenges and Strategies

Choice of an ERP

The introduction of an ERP system in the company

The choice of the ERP

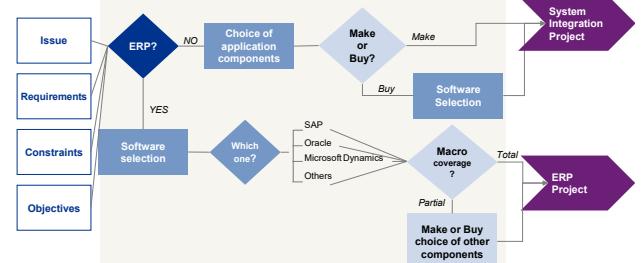
The choice of an ERP should be framed within a broader definition of the application architecture that requires an articulated assessment of both the current technological and organizational situation and the business strategies and critical success factors of the company.



The introduction of an ERP system in the company

The choice of the ERP

Defining Application Architecture: The Logical Path



In terms of the main software vendor for the ERP there are Oracle and SAP, but first there are some keywords that are important to consider. The structure of the software is based on modules, with each module representing a specific area, department, or process. For example, there are modules for the financial department, controlling, sales, purchasing, and production. Each module is connected to the others, meaning that actions in one module can impact other modules.

²Ariba is a cloud-based procurement management solution provided by SAP. It integrates with the core ERP system to automate complex workflows, making it easier for employees to search for goods and services, collaborate with suppliers, and manage approvals and invoices Source 1.

For instance, creating a purchase requisition or order in the purchasing module may require entering financial objects that are key elements in the controlling or finance modules.

ERP Projects

ERP Projects

Impact on the Business



The ERP project is one of the primary agents of business change and a unique opportunity for companies to renew their organizational and cultural system.

The impact of ERP projects that are most significant for the company are those on human resources, on their ways of working.

The business impacts of the ERP project must be addressed and managed with great care both to achieve the project objectives and to contain the project risk.

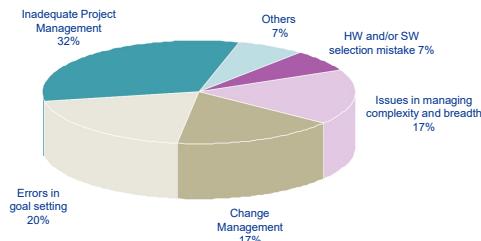
Implementing an ERP system involves three key dimensions: technology, processes, and people. There are several risks associated with ERP projects, as shown by the results of previous campaigns. Project management is crucial, as a poorly structured project plan can lead to issues. Setting clear business objectives from the beginning is essential to manage expectations and measure the benefits of the implementation. Managing complexity and making the right software selection are also important factors.

When starting a project, it is necessary to collect functional requirements by interviewing process owners and key users from each department. These requirements need to be translated into the language of the ERP system to proceed with the implementation. The implementation process includes system setup, testing in a quality environment, user acceptance testing, and training for all users in the company.

ERP Projects

Impact on the Business and Project risks

KPMG conducted a survey of 252 companies. The main reasons for the lack of success of information systems are as follows:



Choosing the right software and implementing it can be complex. Consulting companies often have their own approach and tools to accelerate the process. It is important to consider the business needs and plan for the future when selecting and implementing an ERP

system.

ERP Projects

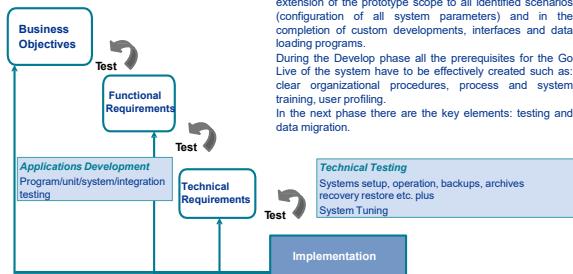
Test and data migration - Build: implementation and testing



The realization of the information system is realized in the extension of the prototype scope to all identified scenarios (configuration of all system parameters) and in the completion of custom developments, interfaces and loading programs. During the Develop phase all the prerequisites for the Go Live of the system have to be effectively created such as: clear organizational procedures, process and system training, user profiling. In the next phase there are the key elements: testing and data migration.

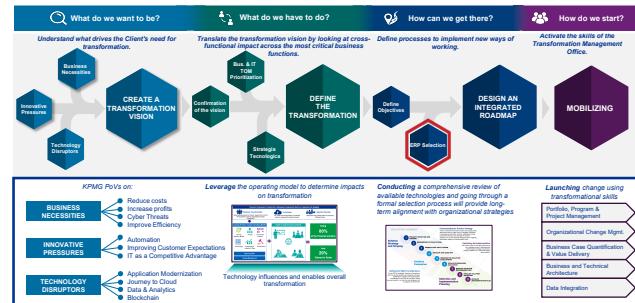
Business Solution Functional Testing

User/System/Acceptance Integration Testing



Recommended Approach

It is important to perform a key strategy and activity planning before implementation



In terms of transformation projects, change management is crucial. It involves explaining the benefits and changes to the organization and its departments. This includes cost savings and potential revenue increases. It is important to consider the current state of the legacy system and its ability to manage processes. If acquiring another company, integration planning is necessary, whether it involves adopting their system or finding a common system. The selection of software depends on specific requirements and constraints, such as supporting collaboration with suppliers. The relationship between processes, technology, and change management is essential. In the case of a global company, localization requirements and multiple instances may need to be considered. The integration of acquired companies and their IT landscape is also a strategic consideration.

KPMG on Low Code

I'm not sure which one of you is familiar with this new term, but it's gaining a lot of attention globally. Although it may not be as popular in Europe and Italy, there is another approach to software development that is worth exploring. While technologies like that may be the current trend, they are not the only ones that software engineers should focus on in the next decade. There are new methods emerging that make software development easier, faster, and more secure. Now, let's dive into the details of low-code development, which is the topic we will be discussing today.

Definition and Scope

What is Low-Code?

Low-Code is an **app development approach**. It combines tools that simplify the entire development process to enable accelerated delivery of business applications. Low-Code requires **little to no coding skills**.

It's a visual approach to software development such as graphical user interfaces (GUIs) and drag-and-drop point-and-click interfaces that can be applied without having to write traditional code. That in combination with numerous out-of-the-box accelerators (e.g., BI module, workflow engine, etc.) allow organizations to build their enterprise-grade applications faster hence lowering the time-to-market of solutions.

Due to the **easy adoption**, Low-Code allows for **quicker development and deployment of solutions with easier access to resources** due to easier training, reskilling and upskilling of professionals vs. traditional development and thus enabling users to be productive quicker.

If set up properly, Low-Code programs can deliver **solutions with limited involvement of IT departments**, support **improved collaboration between agile teams of working**, and reduce the IT bottleneck. Low-Code bridges the gap between the IT infrastructure and the business users to fulfill their specific process requirements.

Low-Code gives organizations the flexibility to **reuse solution components** (e.g., SSO) in various applications, reducing the total cost of ownership. Most Low-Code platforms offer multi-device experiences out-of-the-box, providing end users with a consistent experience on any device.

Additionally, 70% of users who had no experience before using Low-Code platforms learned in one month or less to develop meaningful apps. This allowed them to quickly build smaller scale applications for their departments themselves. A well-structured master data management as well as a sophisticated governance strategy are prerequisites for successful implementation of Low-Code in an organization. Low-Code not only enables organizations to **solve distinct problems** like RPA (robotic process automation), workflow customization and business intelligence. It also allows for **maximum flexibility** in times of increased demand for digital transformation.

Low-code development is more than just a platform or a cloud solution. It encompasses a combination of these elements. Now, let's move on to discuss the major technologies involved in low-code development.

Historical Context and Evolution

Over the past decade, companies have been increasingly focused on optimizing and streamlining their core processes, such as procurement and operations. However, it's important for companies to consider not only their core operations but also the surrounding components that impact their overall efficiency. This includes visualizing and automating common user tasks and leveraging data to improve communication and collaboration with other departments.

In order to foster innovation, companies need to shift their attention and resources towards individuals who can generate new ideas and solutions. One common approach is to automate repetitive tasks or non-value-added activities. This trend started years ago in large US companies, including industrial giants like GM and banks, as well as government institutions. Initially, the focus was on workforce optimization rather than investment analysis. This was a simple and straightforward solution at the time.

Global Trends and Adoption

In order to maintain our jobs and avoid outsourcing to low-income countries like India, we need to take action. We can achieve this by finding skilled individuals in these countries who can perform our job effectively and at a lower cost. By doing so, we can reduce our expenses and present a compelling case to management. This strategy is commonly referred to as "Outsourcing". It is crucial for all of us in the driving industry to understand and embrace this concept.

Automation and Low-Code

In these companies, there is a strong focus on automating activities that were previously done by humans. This is the first aspect of low-code development: automation. The idea behind this approach is to find ways to automate these activities using robotic process automation software. This technology is not new; it has been around for 14 years and is commonly used in various applications. By implementing this technology, companies can streamline their processes and reduce costs.

Analytics and Data

The second aspect we will discuss is analytics. Analytics involves the ability to analyze data collected from various sources within an enterprise software system. It is important to create reports that not only provide valuable insights but also optimize cost-effectiveness. Analytics plays a crucial role in boosting automation. Automation relies on both software and data, similar to how humans require data to perform tasks efficiently. For instance, if a human needs to transfer data from one window to another, they need the data to be organized and in a suitable format. This ensures greater efficiency and effectiveness in the overall process.

Artificial Intelligence and Low-Code

Lastly, but certainly not least, is the application. Sometimes, you need tools to help you understand data and make informed decisions, especially in automated processes. This is where artificial intelligence (AI) comes into play. When AI intersects with low-code development and automation, it creates a powerful combination that can drive international competition.

Low-Code as a Competitive Advantage

In the realm of international competition, the convergence of three key elements—software, robotics, and business operations—is of utmost importance. This combination allows for the creation of applications and technologies that can significantly enhance business operations. One notable advantage of this technology is its ability to automate crucial tasks, resulting in increased efficiency. Moreover, the speed at which these applications can be developed is truly remarkable. With this technology, it is possible to create and deploy applications rapidly.

The Future of Software Development

In the future, the landscape of software development will be drastically different. Currently, companies rely on a large number of employees to write code and build applications. However, with the advancements in analytics, artificial intelligence, and automation, this process will be revolutionized. These technologies will replace the need for manual coding, making it much faster and more efficient.

As a result, the role of universities in teaching high-level programming languages may become less important. The traditional approach to software development will be replaced by low-code development, which allows for faster and more streamlined application building. This means that individuals who are currently studying programming may need to reconsider their career paths, as the demand for manual coding skills may decrease significantly in the next century.

It's important to embrace these changes and adapt to the future of software development. By understanding the potential of low-code development and the power of analytics, AI, and automation, individuals can position themselves for success in this evolving industry.

Low-Code Market Value

Why am I saying this? Because even today, if I want to develop a simple enterprise application that requires some coding, I would have needed to hire a Java or .NET programmer in the past. It would have taken them around 10 to 20 days to complete the task. However, with low-code development, I can do it myself in just one day. This demonstrates the efficiency and time-saving benefits of low-code.

In the near future, I may not even need a person to configure the low-code platform. Companies like Microsoft are continuously improving their low-code tools, making them more user-friendly and accessible. This evolution in low-code development is not just about

individuals, but it also has a significant impact on industries. Low-code has already revolutionized billion-dollar infrastructures, not just small businesses.

The global market value of low-code is currently around \$100 billion per year, indicating a significant shift away from traditional development methods.

The Impact of Low-Code

Job Market and Industry Changes

My role here is to acknowledge a significant shift in the job market. In my interviews with colleagues, I've encountered individuals who aspire to be full-stack programmers, back-end developers, and content developers. While these roles are valuable, it's important to recognize that they may become less prevalent in the future. Companies like ours, have chosen to focus on the strength of technology rather than relying on a large number of developers spread across the globe. We have witnessed the growing importance and popularity of technologies like cybersecurity and bandwidth growth. This is why we have made the decision to invest in these technologies and share this information with you.

The Role of Traditional Software Development

I understand your concerns about your ability to excel in your job and the challenges you face in the software industry. It can be difficult when there is a lack of resources and support. However, it's important to remember that the industry is constantly evolving, and there are new opportunities emerging.

One such opportunity is low-code development, which allows individuals without extensive coding experience to create applications. Low-code platforms provide a visual interface and pre-built components that simplify the development process. This means that even if you don't consider yourself a skilled engineer, you can still contribute to software development.

The rise of low-code development has also led to increased automation in the industry. Tasks that were once time-consuming and manual can now be automated, freeing up valuable time for more complex work. This automation is particularly beneficial in the front-end development space, where there is often a shortage of skilled individuals.

However, it's important to acknowledge that the traditional software development industry is still relevant and necessary. While low-code development offers advantages, there are still complex projects that require the expertise of experienced engineers. It's about finding the right balance and leveraging the strengths of

both approaches.

In conclusion, the software industry is evolving, and low-code development is becoming a competitive advantage. It provides opportunities for individuals without extensive coding backgrounds and enables automation in the development process. However, traditional software development still plays a crucial role in tackling complex projects. It's important to adapt to these changes and embrace new technologies to stay relevant in the industry.

New Opportunities in Software Industry

There is a new and rapidly growing software industry that is gaining momentum. It may seem like a small trend, but it has actually been developing for the past 20 to 30 years. Initially, there were only a few companies involved, but now there are countless players in the market. These companies are often overshadowed by larger, more well-known organizations, but they are making significant contributions in various sectors, including healthcare and media.

The emergence of this new software industry has created numerous job opportunities, but there is a shortage of skilled professionals who are familiar with the technology. One reason for this shortage is that many people are not yet aware of the potential of this industry. Additionally, traditional software developers may be hesitant to transition to this new field.

However, it is important to recognize the potential and embrace the changes that this industry brings. It offers exciting prospects and opens up new avenues for innovation. It's time to break away from traditional norms and explore the possibilities that this new software industry has to offer.

Low-Code in Practice

Intelligent Automation

So, returning to our presentation, these are the tasks that someone working in intelligent automation can perform. It's not just about developing solutions; it involves IT professionals engaging in a wider range of activities. It's not like being a software developer, where you gather requirements, develop an application, and then test and deploy it. In intelligent automation, we also have the task of discovery. We engage in value-added activities to understand how automation can be applied to companies, build those automation solutions, and incorporate elements of cognitive and artificial intelligence. And, ultimately, we also handle management. Let me provide an example. One of our projects serves as a very interesting use case.

Use Cases and Efficiency

For an automotive company that increased its production of luxury cars, there was a challenge related to checking the labels on each vehicle. These labels contain important information, such as the manufacturing location and pressure specifications, and must comply with local regulations and be in the language of the market where the car is sold. Previously, employees on the production line manually checked each label for accuracy and compliance.

To address this issue, a discovery process was conducted to identify opportunities for automation. A solution was developed using a combination of low-code development, cognitive technology, and artificial intelligence. An app was created for tablets used by the employees on the production line. They could simply take a picture of the labels on the car doors and other locations, and an Amazon Web Service configured with label recognition capabilities would automatically analyze the image. The system would determine if the label was correct, in the right position, and compliant with regulations. The results were recorded and archived in the tool.

By implementing this automated solution, the automotive company was able to reduce the number of employees needed for label checking from five to just a couple. This resulted in significant cost savings for the company.

Tools and Technologies

At our company, we go beyond just being software engineers. We strive to find the best solutions and automation techniques to add value to our clients' businesses. We use various tools, such as Microsoft, AWS, and others, to create high-level architectures for automating human activities. One of the tools we use is Robotic Process Automation (RPA), which allows us to automate repetitive tasks. We also utilize HR and cognitive services, as well as low-code development, to build applications. Think of us as painters who combine different technologies to automate work processes. This approach is incredibly powerful and transformative.

Traditional vs. Low-Code Development

If we look back 10 or 20 years ago, the only option for software development was writing code in specific programming languages like .NET or C#. However, today we have a wider range of technologies available to us. This has led to the emergence of low-code development.

Traditional development is a manual process carried out by humans, which can be prone to errors and re-

quires significant resources. Developers often spend a lot of time searching for code, trying to understand it, and sometimes making mistakes that require further investigation. On the other hand, low-code development offers a different approach.

With low-code, developers have access to a palette of pre-built components and services that can be reused. Many of these components have already been created by other developers, allowing for efficient reuse of their work. This is the essence of low-code development: the ability to create applications without having to write traditional code.

The Future of Low-Code

Predictions and Market Trends

Low-code development is gaining popularity due to its ease of use and ability to bridge the gap between business needs and software development. Compared to traditional software development, low-code allows for faster results and the ability to showcase them more quickly. This is particularly important because by 2025, the majority of enterprise application development is expected to be done using low-code. This shift towards low-code presents a significant opportunity for industries to adopt this approach. The low-code market is projected to reach \$30 billion by 2025, making it crucial for businesses to embrace this trend and stay competitive.

Digital Solutions and Legacy Modernization

Low-code development offers a range of possibilities for various applications. One key benefit is the ability to create new digital solutions that can be used both internally and externally. These solutions can be utilized by employees within the company as well as by consumers who want to interact with the organization.

Another valuable use of low-code is the modernization of legacy applications. Many industries, such as banking, still rely on outdated applications developed in the 70s or 80s. With low-code, companies can transition these old technologies to more modern platforms by developing low-code applications.

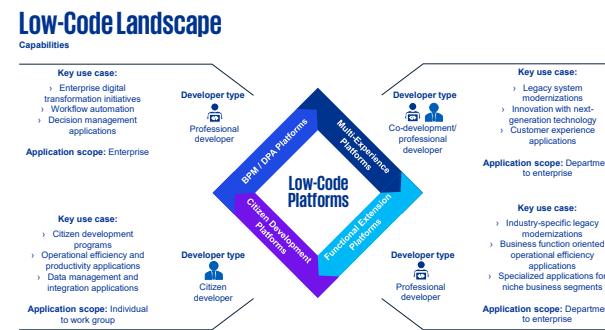
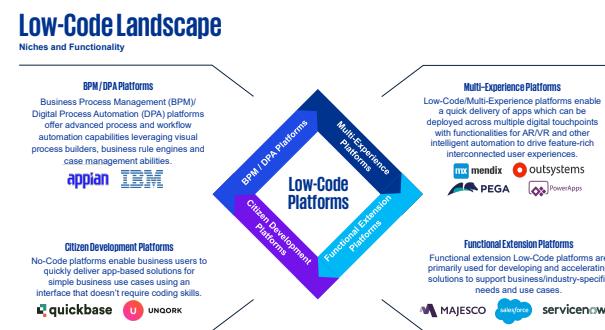
Additionally, low-code can be used to streamline and consolidate applications across different departments. In the past, companies would build separate applications for each department, resulting in a lack of cohesion. Low-code allows for the unification of these applications into a single, integrated system.

Lastly, low-code enables the automation and orchestration of existing processes, as well as the design of new processes. This means that companies can au-

tomate repetitive tasks and workflows, improving efficiency and productivity.

These four areas—creating new digital solutions, modernizing legacy applications, unifying applications across departments, and automating processes—are the primary use cases for low-code development.

Low-Code Landscape



In the landscape of low-code development, there are different types of applications that can be built. One example is multi-experience platforms, which allow you to develop applications that can be deployed on mobile devices, tablets, or web browsers. These platforms focus on providing a seamless user experience across different devices.

Another type of platform is functional extension platforms. These platforms are used to enhance existing enterprise software by configuring and augmenting processes. They enable businesses to extend the functionality of their software without the need for extensive coding.

For those who are new to coding or prefer a more user-friendly approach, there are citizen developer platforms. These platforms require no coding knowledge and are designed to be easy to use for anyone, including non-technical individuals. They are often used by companies to create small-scale applications quickly and efficiently.

Lastly, there are business process management platforms. These platforms are used to digitize complex processes within organizations. By leveraging

these technologies, businesses can develop solutions that streamline and automate intricate processes.

Overall, the low-code landscape offers a range of platforms tailored to different application development needs, from multi-experience platforms to functional extension platforms, citizen developer platforms, and business process management platforms.

Hands-On Exercise

Design Activity and User Experience

Low-code development can be used in various scenarios, such as digital transformation initiatives, workflow automation, creating specialized software for niche industries where enterprise software is not available, and modernizing legacy systems. The versatility of low-code allows for a wide range of applications.

For today's exercise, we will focus on a low-code platform and simulate a project similar to what we do in real-life low-code projects. One of the initial phases in a low-code project is the design activity. During this phase, we need to consider the process, the data involved, the users of the application, and the user interface.

Designing a user interface is a complex task in today's world. We need to develop applications that are easy to use for everyone and accessible across multiple devices. Low-code software can assist in this process by providing a palette of optimized graphic layouts for mobile, laptop, and public use. However, creating a user interface that meets these requirements remains challenging.

For today's exercise, we will focus on user experience (UX) and user interface design (UI).

ACME Company Case Study

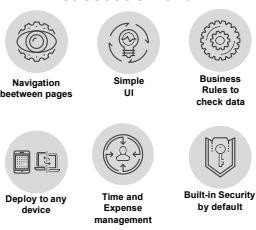
RealLife Scenario

ACME Co. is struggling with its workforce time report.
Employees do not report on time (every week) their time spent on each work item as well their expenses (hotel, air and train ticket, meals and others).

ACME is asking SOFTWARE INC. to design and build an app to collect time report for the employee via web and mobile leveraging its low code platform.

Split in 5 groups (7 people each) and design on powerpoint or better on DRAWIO a wireframe of the UX of the app as well show the link between the different wireframes, in particular:
- Home page for the employee
- Time report page
- Expense report page
Show the result in a brief presentation of 5 minutes each

Success Criteria



ACME, a company, has approached us to develop a workforce time report. A time report is essentially a calendar where individuals working on projects or for a company can log their time. They record the number of hours spent on specific tasks, such as training, project

work, or email responses. ACME has requested us to design the entire solution, including the user interface.

When it comes to the user interface, our usual approach is to create a wireframe. A wireframe is a sketch of the user experience that takes into account the technical requirements of IT software. It needs to be compatible with webpages, easy to use, and mobile-friendly. Designing a user experience is a complex task that requires careful consideration.

To facilitate this process, we recommend using a tool like Draw.io. It allows us to create detailed wireframes that align with ACME's needs and preferences. By collaborating as a group, we can ensure that the final design meets all the necessary criteria for a successful workforce time report.

Success Criteria and Business Rules

One of the free tools available on the web for building a user experience is wireframing. While you can use PowerPoint, I strongly recommend using a tool specifically designed for this purpose. To create the wireframes for ACME Company, we need to start with an on-page for the employee. As an employee, I would need to enter my username and password, and there could also be additional authorization steps such as multi-factor authentication or a one-time password. We also want to include navigation to the time report page and an expense report page.

The expense report page is where employees can enter their expenses, such as travel expenses. This page should allow users to input details about the expense, including the date, type, receipt upload, amount, and location. It's important to consider all the necessary information for expense reporting.

When designing the wireframes, it's crucial to keep in mind the success criteria. As consultants, we are always evaluated based on these criteria. One important aspect is the navigation between pages. It's common for teams to focus on designing beautiful pages but overlook the seamless transition between them. Users should be able to easily navigate back and forth between pages, as mistakes can happen during data entry.

Another consideration is the user interface (UI). Avoid using large white boxes on a page, as this can be a common mistake. Just like you as a consumer wouldn't appreciate a lackluster UI on your iPhone or Android, it's important to judge your own design from a user's perspective. Additionally, it's essential to define the business rules behind each page. These rules will guide the functionality and behavior of the application.

By taking these factors into account and creating

wireframes that prioritize user experience, navigation, and a visually appealing UI, we can ensure the success of the ACME Company application.

Closing Remarks and Exercise Instructions

For example, let's consider a validation process. It's important to ensure that expenses are only entered for the days worked. Keep in mind that these validations are not optional—they are necessary. Additionally, it's crucial to make sure that the user interface (UI) is responsive and adaptable to different devices. Instead of relying on adjusting the power pointer, it's recommended to utilize the UI, which is accessible across all devices. Remember, we are not just focusing on time, but also on expenses. It's important to consider the user experience and not overlook the needs of the users. Lastly, building security is essential. An authentication mechanism should be implemented to protect sensitive data. This exercise is designed to help you understand the group's requirements. Since there is a lot of work to be done and a meeting scheduled for later this afternoon, it would be beneficial for you to start working on it now.

Web Information Systems - I Lecture

Introduction and Definition of WIS

Good morning! In this class, we will be discussing web information systems. As usual, you can find the slides on WEBEEP. Let's begin by defining what a web information system is.

- Definition of WIS as a system where:
 1. The communication among machines (servers and clients) uses the public Internet or an IP-based private VPN
 2. Users access functionalities through a browser



It represents a very broad definition including both sites and portals, as well as traditional information systems (core ERPs) redesigned to provide their functionalities through the Internet with a browser-based interface.

A web information system is a system that facilitates communication between machines using either the public internet or an IP-based private VPN. Users can access the system's functionalities through a web browser. This definition provides a broad understanding of what a web information system entails.

Defining Web Information Systems The public internet and the IP protocol, along with browsers, have brought about significant changes in information systems. Any system that meets two criteria can be considered a web information system. Firstly, it must be accessible through a browser. Secondly, it should be connected to the private VPN of the company. This means that even a traditional ERP with its core functionalities can be classified as a web information system if it meets these criteria.

Impact of Technical Innovations

These two technical innovations—internet and browsers (user interfaces)—have resulted in a transformation of the technologies utilized, even by components of web information systems that were created prior to the advent of the web. In essence, ERP providers have reimagined the interface and core technologies of their packages to align with this new paradigm.

The Internet and Its Influence

Now, let's discuss the main innovation that revolutionized web information systems: the internet. The internet connected companies to individual customers for the first time, marking a significant change in the business landscape. This not only impacted individual customers but also the employees working for these com-

Innovation with WIS

- The Internet is a network that has brought connectivity to individuals → companies are connected with their retail customers
- Nov. 2000 stock exchange failure (dot com bubble)
- The Web is a window on a company's processes (and their performance)
- The quality of Web sites and portals cannot be high if companies have not completed the integration of their information processes (common unified data, consistent omni-channel processes)
- The Web is the enabling technology of customer relationship management (CRM) and allows the omni-channel integration of service distribution
- As omni-channel integration is deployed, the Web becomes the single access point for both customers and internal users

panies. The ability to connect the company's potential market, especially retail customers, through a public network was seen as a monumental shift.

During the late 90s, when the internet was introduced, there was a great deal of hope and belief in the transformative power of this new technology. There was a hype surrounding the web, with expectations that it would drastically change people's lives in a short period of time. The paradigm of exponential organization emerged, where companies without the burden of physical shops or channels to reach customers could experience rapid growth. As a result, the value of web-based companies experienced significant growth around the year 2000.

The Dot Com Bubble The dot com bubble refers to a period when the value of stocks of companies with websites ending in ".com" skyrocketed, far exceeding their actual revenues and assets. However, this rapid growth was eventually followed by a significant stock market crash, one of the largest in recent history. This sudden shift from extreme optimism to pessimism marked a turning point in the market.

Web Technology in Traditional Companies The web has undoubtedly revolutionized processes for both traditional and new companies, creating new industries while also causing the decline of others. However, the pace at which society adapted to these changes was slower than the expectations of the stock exchange. For traditional companies to fully benefit from web innovation, they must first go through the implementation and integration of their information systems, even with traditional technologies. Without this, it is challenging for them to compete effectively on the web, unless they have a history of being highly innovative in their approach to information systems and are prepared to utilize the web as a new channel to reach customers.

For instance, companies that lack a unified data system, which is a fundamental aspect of the ERP paradigm, will struggle to provide a satisfactory web service. The web is a more objective platform compared to a physical store, as there is no personal interaction. Customers have certain expectations for ser-

vice quality, which are set by industry leaders. Consequently, the web can actually make the customer relationship more challenging rather than easier. Only companies that have successfully integrated previous technologies into their operations have been able to fully exploit the potential of the web.

Extended ERP and E-Commerce When examining the functional architecture of ERP systems, it becomes clear that extended ERP is more influenced by the web than core ERP. The web has opened up new opportunities, particularly in e-commerce, which continues to evolve. Extended ERP, which is enabled by the web, encompasses various functionalities that must be supported by a well-integrated and IT-supported internal process.

One of the key enabling technologies for extended ERP is CRM, with the web playing a significant role. While companies have been using technology, such as Salesforce automation, to interact with customers for some time, the web has made it easier to showcase services, prices, and conditions, as well as compare alternative suppliers. This has created a need for integration across different channels, as any mistakes or inaccuracies on the web are visible to all. It is no longer acceptable for customers to have to visit a retail shop for information; it must be readily available and accurate on the web.

E-Commerce and Its Evolution

Companies have recognized the importance of integrating customer information into a single database, commonly known as a customer database or CRM. This integration, whether referred to as omni-channel or multi-channel, has become increasingly important as the web has become the primary access point for both customers and internal users.

- eCommerce is the activity of buying or selling of products (goods or services) on online services (ref. Wikipedia).
- Most eCommerce services are on the Web.
- The term eCommerce usually refers to *retail* customers.
- The term eBusiness is used to refer to business customers.
- The term eGovernment is used to refer to services offered by public institutions to citizens.

Initially, the web was seen as a platform for e-commerce, allowing companies to sell their products online and reach a wider market. This was seen as a significant opportunity. E-commerce refers to the buying and selling of products and services online, primarily targeting retail customers. On the other hand, when referring to business customers, the term e-business is used. For example, if a company purchases from another company online, it is considered e-business. Similarly, if a public administration buys from a supplier online or provides services to other public institutions

or citizens, it is referred to as e-government.

In summary, e-commerce focuses on reaching the market and selling products online, while e-business and e-government encompass a broader range of online transactions involving business customers and public administrations, respectively.

The Dot Com Trend and Its Aftermath

In the early days of the dot com trend, many companies initially set up their e-commerce operations as separate units or even separate companies. This was a common approach when a new technology brought about significant changes. These companies lacked the necessary expertise to effectively manage and leverage the new technology, so they sought the help of consultants and formed internal teams to handle it. Over time, these teams evolved into dedicated units focused on the new technology, such as the web.

- eCommerce sites have been often implemented by separate teams, often involved in rebranding initiatives (e.g. Bank24 - Deutsche Bank)
- The design of eCommerce sites involves a variety of competences (typically, IT + design + product innovation + marketing)
- The management of eCommerce sites involves new competences, in particular editors creating and updating content
- The Web is a distribution channel, a production technology, and a source of external information → it involves revolutionary change

This pattern of innovation is not unique to the web; it has been observed in various industries. However, during the dot com era, companies that were perceived as pure dot coms, operating solely on the web without any traditional brick-and-mortar presence, were highly valued in the stock market. This led even traditional companies to establish separate units or even separate companies with their own distinct brands to tap into the potential of the web. For instance, in 2000, Deutsche Bank launched Bank 24, a web-only bank operating as a dot com.

However, this trend came to a halt after the dot com bubble burst and the subsequent stock market failure. Even Deutsche Bank eventually integrated Bank 24 back into its core services, recognizing the need to reassess their approach in light of the challenges faced by dot com companies.

Integrating Web and Traditional Channels

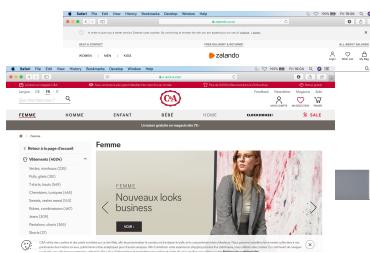
Companies have recognized the importance of integrating the web as an additional channel for their existing customers. There are a few reasons behind this realization. Firstly, companies understood that relying solely on the web for growth and stock market success was no longer feasible after the dot com bubble burst. Secondly, they realized that web-based operations still re-

quire physical processes and the management of people, offices, and complementary services. This led to the recognition of the synergies between web-based companies and traditional structures, as Deutsche Bank recognized.

To leverage these synergies, companies brought web-based operations back into their traditional structures and began integrating the web as a channel alongside other existing channels. This integration process was facilitated by customer relationship management (CRM) practices. Companies started by creating a shared customer database and analyzing it to understand the evolving habits of web customers. Based on these insights, they developed innovative services to cater to the changing needs of web customers over time.

eCommerce – examples

- eFashion, fashion eCommerce, digital fashion
- eGrocery
- eTourism/eTravel
- eBanking
- eTrading
- eLearning, MOOCs
- eBooks
- eTicketing
- video/music streaming
- eGaming



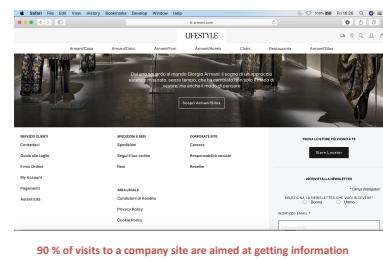
Initially, customers were skeptical about making purchases on the web, especially for high-value or high-quality products. They preferred traditional brick-and-mortar shops. However, over time, customer behavior shifted, and e-commerce gained traction across various industries. The pace of this shift varied across industries, with some experiencing faster adoption than others. Nevertheless, e-commerce has become prevalent in almost all industries, including fashion, grocery, tourism, banking, trading, and learning. Each industry has its own specific terms and practices related to e-commerce.

The Role of E-Commerce Post-COVID-19

When the internet was first introduced, there were predictions about which industries would be most impacted by e-commerce and how quickly it would replace traditional channels. However, it took nearly 20 years for e-commerce to become pervasive, serving only a small percentage of transactions and clients. The COVID-19 pandemic changed this dramatically, giving e-commerce a significant boost. It quickly developed and penetrated the market, reaching a larger audience. While there has been a slight decline after the initial surge, e-commerce has still experienced substantial growth and increased penetration.

Customer Journey and Online Information

To illustrate this point, let's consider the example of grocery shopping. Despite the pandemic, only a small percentage of people actually do their grocery shopping online. This indicates that the experience of shopping in a traditional store or through traditional distribution methods is still considered superior to the online experience. As a result, the current trend is to view online shopping as complementary to other channels, rather than a standalone option.



- **Presentation of company**
 - Mission and objectives
 - Organization structure
 - Balance sheet
 - Press reports
 - News and events
 - Work with us
- **Product information:**
 - (Product catalog in pdf)
 - Multimedia online catalog
- **Contacts:**
 - Call center
 - Company sites, agencies, etc.
 - Map

When customers engage with a company, they go through a journey that involves multiple channels at different stages of the transaction. It all begins with a need, which may arise from seeing an advertisement or simply having a requirement. The first step in this journey is typically going online to gather information. This initial step is crucial in the transaction process and is usually done through the web. When customers are unsure of where to make a purchase, they turn to the internet to find information. This helps them make decisions about the provider, the brand, and the specific product they want to buy. With the advent of social media, customers also rely on product reviews to guide their choices. This search phase of the transaction, where customers seek information, accounts for approximately 90% of visits to a company's website.

Designing Effective Web Information

The main purpose of websites is to provide information to customers who are looking for products or learning about a company for the first time. Typically, websites include a general presentation of the company, its mission, organizational structure, job opportunities, news and events, and information about its products. Some older websites may offer a downloadable product catalog in PDF format or a multimedia online catalog where customers can browse through the products. These websites often provide recommendations for related products that are commonly purchased together. Contact information, such as the call center, company size, and location, is also provided, sometimes with a map for easy navigation.

When designing the information services of their website, companies are primarily concerned with pro-

viding a positive first impression to customers who have no prior knowledge of the company. This can be challenging for companies, as they need to carefully design the website's navigation structure. It is often best to follow a navigation structure that is similar to what competitors use, as customers have certain expectations about where to find specific information on a company's homepage. Keeping the information provided on the website standardized is a good idea, although it should be regularly updated as company information, including the mission, can change over time. To update the information on their website, companies need to gather the necessary information from various stakeholders within the organization who possess the relevant knowledge. This can be a complex task, as information is often scattered across different departments or individuals. The website serves as a central access point for customers to find all the information they need.

Quality Criteria for E-Commerce Sites

- Issues:
 - Design a navigation structure for information and online services
 - Retrieve information
 - Constantly update information
- Solutions
 - Federation: one central site with general information and services and multiple local sites serving different organizational units that are locally managed (e.g. university/departments)
 - Editorial committee: it should be created at the beginning of the WIS project and it becomes a permanent organizational unit
 - Help desk: the call center and the Web should be tightly integrated.

In order to provide consistent information to customers on the web, information owners must cooperate. There are two approaches to collecting this information. The first approach is federated, where there is one central site with a thin layer of information and multiple local sites where individual business units can provide their own information. The landing page serves as a collection of links to the different business units' websites. While this approach allows for information retrieval to be closer to the business units, it often results in a website that lacks standardization and has lower overall quality.

The second approach is to establish an editorial committee that constantly updates the information on the website. This committee seeks information from the different business units and follows a common template for all units, ensuring standardization. Although this approach is more expensive due to the need for an editorial committee and agreement on the information to be provided, it generally leads to higher quality.

When considering the quality criteria for an e-commerce site, there are several factors to consider. First, customers expect the content to be complete, dependable, and correct. They also want consistency in the information provided by the call center. Second, the structure of the website should allow customers to easily navigate and understand the information. A cen-

- Content– It represents the quality of the information and services provided by the site. It depends on:
 - Completeness
 - Dependability, i.e. user ability of assessing the correctness of information
- Structure– It describes the quality of the structure of content and depends on:
 - Centralized vs. federated; if federated different organizational units provide diverse information with no standard (quality is lower, but it is cheaper)
 - Understandability, i.e. users' ability to build a conceptual model of the site that supports easy retrieval of information and easy interpretation/use.
- Presentation– It describes the quality of the Web interface and depends on:
 - Graphics, i.e. appeal and visualization tools
 - Coherence of graphic style
 - Page layout, i.e. position of information and links
- Navigation:
 - paths
 - intuitiveness
 - reference points (e.g. «home» or «back»)
 - Interaction (amount of cross-links)

tralized structure is preferable in this regard. The presentation of the website should have a coherent graphic style to instill trust and confidence in the company. The layout and position of information should be intuitive and standardized. Navigation should also be intuitive, with multiple paths to reach the same information. The website should be well-connected, allowing customers to navigate between pages without having to return to the homepage. The ease of navigation, including the ability to go back multiple steps, is crucial.

In conclusion, the quality criteria for an e-commerce site include content completeness and dependability, a clear and intuitive structure, a coherent graphic style, and easy navigation with multiple paths to reach information.

Web Information Systems - II Lecture

Introduction to Web Information Systems - Part Two

Welcome to part two of our series on web information systems. In this installment, we will delve deeper into the fascinating world of web-based information systems and explore their various components and functionalities. So, let's jump right in and continue our exploration of this exciting topic.

In part one, we introduced the concept of web information systems and discussed their importance in today's digital age. We learned that web information systems are designed to collect, process, store, and disseminate information over the internet. They play a crucial role in facilitating communication, collaboration, and decision-making in various domains, such as business, education, healthcare, and government.

Now, let's move on to the key components of web information systems. At the heart of any web information system is the web server, which acts as the central hub for storing and serving web pages and other resources. The web server receives requests from clients, such as web browsers, and responds by sending the requested information back to the client.

Another essential component of web information systems is the database. The database stores and organizes the vast amount of data that is generated and used by the system. It allows for efficient storage, retrieval, and manipulation of data, ensuring that the system can handle large volumes of information effectively.

Web applications are another critical element of web information systems. These applications are responsible for processing user requests, generating dynamic content, and providing interactive features. They enable users to perform various tasks, such as submitting forms, conducting searches, and accessing personalized information.

To ensure the security and integrity of web information systems, authentication and authorization mechanisms are implemented. Authentication verifies the identity of users, while authorization determines what actions they are allowed to perform within the system. These mechanisms help protect sensitive information and prevent unauthorized access.

In addition to these components, web information systems often incorporate other technologies and tools, such as content management systems, search engines, and analytics platforms. These tools enhance the functionality and usability of the system, allowing for efficient content creation, search capabilities, and data analysis.

In conclusion, web information systems are complex and multifaceted systems that enable the collection, processing, storage, and dissemination of information over the internet. They consist of various components, including web servers, databases, web applications, authentication and authorization mechanisms, and additional tools and technologies. Understanding these components is crucial for building and maintaining robust and effective web information systems. Stay tuned for part three, where we will explore the design and development process of web information systems.

Gaining Online Visibility

Now that we have discussed the quality criteria for websites, let's take a closer look at what makes a website truly exceptional.

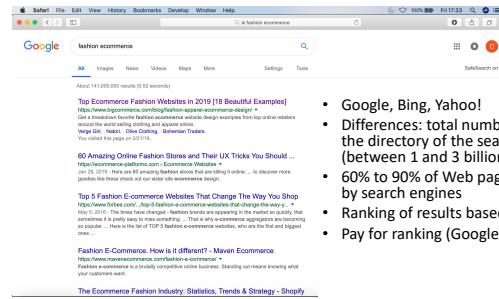
Search Engines and User Behavior

Despite having a high-quality website, companies still need to ensure that their online presence is visible. So, how do companies initiate the search phase of a transaction? Well, they start by going online and conducting a search on popular search engines like Google or Bing. It's worth noting that Google is the most widely

used search engine, with a near monopoly in certain countries, particularly when it comes to web searches. When conducting a search, people usually look for a specific product or service.

Google's Dominance and Search Patterns

In many cases, when you're searching online, you may not know the specific brand or company name for the product you need. Instead, you have a general idea of the type of product you're looking for. For instance, if you're in need of a pair of running shoes, you might simply search for "running shoes".



- Google, Bing, Yahoo!
- Differences: total number of Web pages in the directory of the search engine (between 1 and 3 billion pages).
- 60% to 90% of Web pages is not considered by search engines
- Ranking of results based on term similarity
- Pay for ranking (Google adwords)

When you enter a search term into Google, it aims to provide you with a wide range of relevant results. Google takes pride in displaying a large number of potential websites and useful links that address your search query. For example, in the figure provided, the search term was "fashion e-commerce", and Google informs us that there are nearly 150 million possible sites that could meet this need.

Importance of Top Rankings

When users perform a search, they typically use common and direct terms. As a company, it is crucial that your website's landing page appears in the search results and that users click on the provided URL to visit your site. However, it's important to understand that Google displays search results in a text format, and users often need to click on the links to determine if they are interested in the content. Simply reading the brief description provided by Google is often not enough.

So, how patient are users when it comes to clicking through search results? Studies have shown that if your company's website is ranked below the 10th position on Google, only 10% of users will click on the link. This percentage decreases even further for results ranked between 10 and 20. In fact, only one in 100 users will click on these results. This highlights the importance of achieving a high ranking in the search results.

It's crucial to note that very few users venture beyond the first page of search results. While it is possible to navigate to the second page, the majority of users

do not go that far. Therefore, it is essential to aim for a top ranking to maximize online visibility and attract potential clients.

User Search Habits and Implications

It has been shown that Google is generally effective in providing search results. However, for niche searches, the best fit result is often found within the top 100 results rather than the top 10. This means that it is important to be patient and take the time to go through the first 100 results, clicking on various landing pages to find the best one. This level of thoroughness is typically expected from someone conducting accurate market analysis. However, for the average user, especially a potential retail customer, the priority is to find what they are looking for quickly. If a result is not found within Google's top 10, there is a tendency to assume that it does not exist. This is the conclusion that most people draw when they cannot find a result within Google's top 10.

Google's Role in Visibility and Monetization

It is a common belief among retail customers that if a search result is not within the top 10, it may not exist or be relevant. This behavior can be conscious or unconscious, leading customers to give up on their search after the first page of results. As a result, companies strive to appear in Google's top 10 search results, as this is where most visibility and traffic come from. Google capitalizes on this demand for visibility by selling advertising space through its Google Ads platform. Companies can pay to have their websites appear in the top results for specific keywords.

However, this does not mean that the web provides perfect market conditions for companies. In reality, companies must navigate through a funnel controlled by Google, the dominant player in the search engine market. Google profits from other companies' desire to rank high in its search results. Whether this arrangement is fair or not is not for us to judge in this course. Nevertheless, this system has been in place and functioning for the past 20 years.

Digital Divide and Marketing Strategies

Challenges for Small Companies

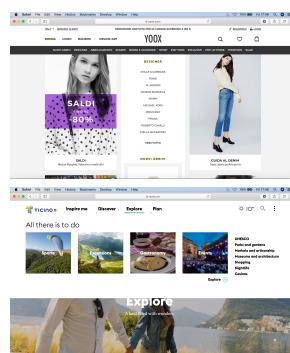
The digital divide poses a significant challenge for small companies, especially when it comes to marketing. Limited financial resources make it difficult for these companies to appear in search results. However, even with a small budget, there are still ways to optimize

Google campaigns and gain visibility in a niche market. This niche can be geographical or specific to less mainstream keywords, such as niche issues or fashion e-commerce.

Optimizing Google Campaigns and Niche Visibility

In the realm of digital marketing, optimizing Google campaigns and targeting niche audiences can help overcome the challenges of the digital divide. While the concept may seem less mainstream, it is still a viable strategy for businesses operating within a limited budget. By focusing on a specific niche, companies can achieve visibility and make an impact, even with limited resources.

Marketplaces as a Solution



- They sell products and services from multiple companies, e.g.:
 - Geographical brands (e.g. «Franciacorta» or «Ticino»)
 - Users' needs (aggregators, e.g. Yoox).
- Companies should share order management and delivery processes.
- Common within districts for SMEs.
- Standard in mobile app market (App store, Play store).

Companies have responded to the opportunities and limitations of the digital landscape in various ways, particularly when it comes to budget constraints. One effective strategy they have employed is the creation of marketplaces. Instead of solely focusing on establishing their own online presence, companies choose to participate in existing marketplaces. These marketplaces can gain significant popularity, such as in the fashion industry where they may be associated with well-known brands like Franciacorta or Ticino. The main concept behind marketplaces is that multiple companies pool their resources to cover the costs of online visibility. This approach offers clear advantages, as companies can share the financial burden of establishing a strong online presence, which can be quite substantial.

The Case of Yoox and Fashion Brands E-commerce has brought both advantages and disadvantages to fashion brands. Take the case of Yoox, an e-commerce platform that sells products from established fashion brands. Initially, these brands overlooked the potential of online sales, believing that fashion products were not suitable for e-commerce. However, over time, consumer habits have changed, especially among younger demographics. It has become common for people to visit physical stores to try on products and then

make their purchases online, seeking better deals or unique offerings.

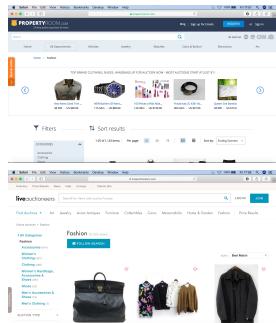
While this shift in consumer behavior presents opportunities for fashion brands, there are also risks involved in not embracing technology and the online market. Many fashion companies now aspire to establish their own brand presence instead of relying on platforms like Yoox, as these platforms take a percentage of sales. By building their own online presence, brands can maintain greater control over their image and profit margins.

Online Auctions and Dynamic Pricing

Concept of Online Auctions

There are various ways to share the costs of visibility as a small provider or seller. One effective method is to utilize online auction services such as CDE. These platforms offer a range of online auction options, some of which cater to specific product niches. These auctions operate based on the concept of dynamic pricing, also known as options.

Types of Auctions



- Ascending (or English) auction: The vendor sets a minimum price. The product is sold to the last highest offer (with timeout).
- Descending (or Dutch) auction: The vendor sets a maximum price that is decreased by a fixed amount at regular time intervals down to a minimum price. The product is sold to the first client offering to buy at the current price.
- Vickrey auction: all customers make an undisclosed offer within a given time frame. The product is sold to the second highest offer.

Ascending Auctions In the realm of dynamic pricing, there is a type known as ascending auctions. These auctions are particularly suitable for goods or services that are scarce. For example, if you have a piece of furniture with historical value, it can be sold online through an ascending auction. Since there are not many similar items available on the market, the price for such a unique piece can vary greatly depending on its condition.

In ascending auctions, the seller sets a base price and a minimum price. Potential buyers then make offers, and the product is ultimately sold to the highest bidder. It's important to act quickly in these auctions, as there is a time limit for making offers. If you don't make a timely bid, you risk losing the opportunity to purchase the item.

Descending or Dutch Auctions The rush to make offers in dynamic pricing is a key aspect of the mechanism, especially when dealing with limited goods or services like cars. In perfect market conditions, there would be an abundant and unlimited supply of the good. However, in reality, this is not always the case. To ensure you get the best price in such conditions, an environment is created where people are inclined to make instinctive, rather than entirely rational, offers. This leads to the price being raised accordingly.

One type of auction that employs this strategy is the descending or Dutch auction. In this type of auction, the vendor sets a very high maximum price, which is then gradually decreased at regular time intervals. The item is sold to the first client who stops the offer and is willing to buy at the current price.

The sense of urgency remains, but the mechanism changes. The choice between ascending and descending options depends on whether you, as a vendor, are unwilling to sell below a certain base price or if the market is unlikely to purchase above a specific amount.

Vickrey Auctions Another option is the Vickrey auction, where customers submit undisclosed offers within a set timeframe, and the product is sold to the second highest bidder. This type of auction is commonly used for tenders in the public administration and by companies.

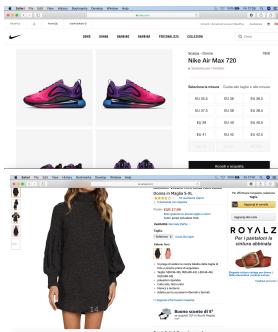
When companies need to purchase goods or services from a supplier, they often use a document called a request for proposal (RFP). This document is published and a selected number of suppliers are invited to participate in an auction. The suppliers are required to submit another document that explains how they will meet the requirements outlined in the RFP. Additionally, they must include a separate envelope with a price for the goods or services they are offering.

The reason why the product is sold to the second highest offer is to prevent dumping. Dumping occurs when larger companies enter the market by offering extremely low prices to gain market share. This can create a monopoly and limit competition. By selling to the second highest offer, companies can avoid dumping and promote a diverse market.

In some cases, auctions may prioritize the quality of the document that explains the product or service being offered by the supplier. This emphasizes the technical quality and ensures that the client receives the best possible solution.

E-Commerce Functionalities and Customer Profiling

Advanced Functionalities



- Product configuration
- Pricing
- Online orders (digital signature vs. login)
- Payment
 - Credit based (credit cards)
 - Debit based (Paypal)
 - Token based (Bitcoins)
- Order status
- Transaction log
- Online services
- Post sale services
- Customer profiling

E-commerce offers a range of advanced functionalities to meet the needs of customers, whether it's through a marketplace or the commerce side of a company. These functionalities are designed to enhance the customer experience and provide efficient and effective solutions.

In e-commerce, there are several advanced functionalities that enhance the customer experience. These include product configuration, pricing, and the ability to place orders online. Customers have the convenience of ordering and paying for their purchases on the website using various payment methods such as credit, debit, or token-based payments. They can also track the status of their orders online and access post-sale services if they encounter any issues.

Recommendation Systems and Personalization

- Collaborative filtering
 - Recommendations are based on each customer's past purchasing behaviour
 - Recommendations are based on past purchasing behaviour of customer segments (that is subsets of customers similar by either static characteristics from catalog information, such as age, location, etc., or dynamic behavioural characteristics)
- Content based
 - Recommendations are based on the similarity of products or product categories (up-selling)
 - Recommendations are based on the complementarity of products or product categories (cross-selling)
- Hybrid: a combination of collaborative filtering and content based

Recommendation strategies should be consistent with business objectives:

- Increasing sales for low-turnover or high-stock products
- Promote new products
- Prevent churn
- ...

As customers shop online, companies collect information about their purchases to create customer profiles. This process, known as customer profiling, helps companies understand their customers' preferences. For example, if a customer clicks on a pastel-colored item, the recommendation system will show them related products, such as sauces for pasta. The recommendation system typically uses a combination of collaborative filtering and content-based filtering, depending on the company's business objectives.

When it comes to recommendation systems in e-commerce, personalization is crucial, especially for

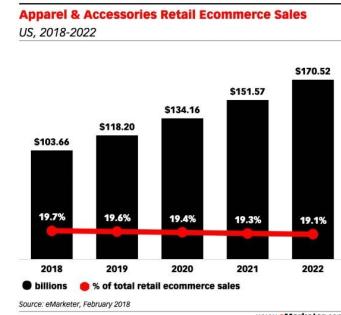
companies that cater to different market segments, such as the mid-market, low-end, and up-market. However, if a company serving the up-market purchases an off-the-shelf recommendation system that operates like Amazon's, there can be some challenges.

Typically, these off-the-shelf recommendation systems tend to suggest mass-market products. This poses a risk for companies serving the up-market because they may end up consistently recommending mid-market products to customers who prefer up-market products. As a result, instead of upselling and offering higher-priced products to increase revenue, the company may unintentionally downsell and offer lower-priced products.

In the best-case scenario, customers who are looking for up-market products may simply ignore these recommendations because they are not aligned with their preferences. However, in the worst-case scenario, customers may find some interest in the mid-market recommendations and choose those instead of the higher-priced up-market products. This can lead to lower revenues and margins for the company.

Growth Trends and Market Penetration

- eFashion is growing fast
- eFashion is growing comparatively less than other types of eCommerce
- The percentage of eCommerce sales varies markedly by product segment, from around 2% for grocery to more than 20% for apparel to the overwhelming majority of sales in categories where products can be digitally delivered, like music, books and games (source: Forbes).



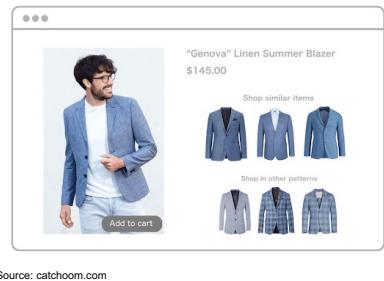
The extent to which e-commerce technologies are adopted depends on the industry. In the case of e-fashion, it currently holds a market penetration of approximately 20%. This means that 80% of sales still take place in physical stores or through other channels. This is an important observation because it highlights that e-commerce is just one channel among many. Traditional companies must utilize multiple channels if they wish to maintain their current revenue levels.

Innovative E-Commerce Technologies

Product Recommendations

To illustrate this point, let's consider advanced product recommendation systems that leverage visual similarity. These systems are particularly relevant in the fashion industry.

Similar product recommendations



Source: catchoom.com

Webshop visitors often abandon the site when an item is **out of stock, not in their size or it is not exactly what they were looking for.** Through **computer vision** it is possible to automatically suggest similar items when a customer is taking a look at a specific garment or accessory, **reducing the chances of abandonment.**

Recommendation engines (based on customer segmentation)

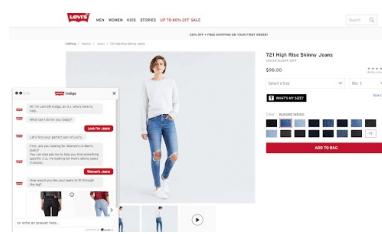


Source: catchoom.com

Retailers' goal has become to **personalize merchandising**, depending on their customers' taste. This is the main reason why AI-powered recommendation engines are quickly gaining ground in the eCommerce field. They provide personalized product recommendations based on user behavioral data and are often presented in the form of "**You may also**"

Chatbots and Virtual Assistants

Virtual assistants, chatbots



Source: catchoom.com

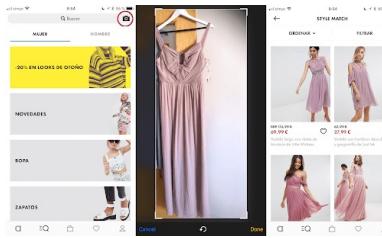
Another way to enhance personalization in e-commerce is by utilizing innovative technologies such as chatbots and virtual assistants. These tools can serve as shopping assistants, providing personalized recommendations based on the products you are interested in. For example, when you are browsing a specific product, the chatbot or virtual assistant can show you other similar products with different customization options, allowing you to personalize your purchase. This visual representation can help you make informed decisions and find the perfect product that suits your preferences. Additionally, chatbots and virtual assistants can provide real-time assistance, answering any questions you may have and guiding you through the shopping process. These technologies not only enhance the customer experience but also streamline the purchasing journey, making it more efficient and enjoyable.

To excel in the e-commerce industry, it is crucial to have a deep understanding of customer preferences and be able to recommend suitable products. This is where the application of AI can be highly beneficial. By work-

ing tirelessly and becoming skilled at interpreting and learning a customer's style, you can effectively propose products that align with their preferences. This personalized approach can greatly enhance the customer experience and increase satisfaction.

Visual Search and Style Building

Visual search



Source: catchoom.com

Visual search aims at enabling consumers to take a picture of a product in order to search for it online. With the use of computer vision and image recognition, visual search solutions match the image uploaded by the consumer and with the retailer's closest image in their catalog.

Another innovative e-commerce technology that is worth exploring is visual search. With visual search, customers can simply take a picture of an item, such as a dress, and the recommendation system will search for similar dresses and suggest them. This feature allows customers to easily find products that match their desired style, making the shopping experience more convenient and efficient. By incorporating visual search into your e-commerce platform, you can provide a seamless and enjoyable shopping experience for your customers.

Conclusion and Transition to Part Three

Lastly, it is important to mention that your recommendation system can also incorporate AI to personalize the style of recommendations based on a specific client's purchases. This concludes part two of the lecture, and in part three, we will delve into web information systems, with a specific focus on supply chain management.

Web Information Systems - III Lecture

Introduction to Supply Chain Management

Welcome to part three of our discussion on web information systems, where we will be focusing on supply chain management. In the previous sections, we explored the impact of e-commerce on retail customers and how web information systems have revolutionized the way businesses interact with their customers. However, it's important to note that the web is not only

used for e-commerce but also for e-business, specifically in the context of coordinating exchanges and transactions along the supply chain.

Supply chain management is a crucial aspect of e-business, where the web serves as a platform for businesses to collaborate and execute transactions with their partners along the supply chain. This innovative application of web information systems has transformed the way businesses operate and has led to significant improvements in efficiency and effectiveness throughout the supply chain.

In the context of supply chain management in retail, the focus is on the product that is ready to be sold to the end user. For example, when a customer searches for “rammy shoes” and clicks on an e-fashion shop that sells those shoes, they become the end user of the product. However, in the realm of supply chain management, the interactions and exchanges do not directly involve the end user.

Understanding Supply Chains

Definition and Components

Supply chain management: definition

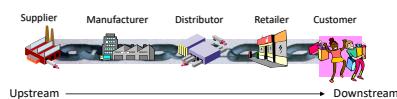
- Software supporting SCM coordinate and integrate all activites along a value chain involving multiple companies, from the downstream company that receives orders to the upstream suppliers working on base resources and materials.
- Fundamental benefits: cost reductions, service level improvement, flexibility.

Supply chains consist of multiple businesses that work together to produce and distribute a specific product. It's not just one company involved, but rather a chain of companies that each handle different aspects of production and distribution. These companies collaborate to ensure that the product moves from raw materials to the final product and reaches the end customer. In essence, a supply chain is a network of companies that produce and sell the same product, with a shared focus on serving the end users of that product.

Complexity and Management

SCM: objectives

The supply chain is composed by:



Goal: adapt supply to demand



In supply chain management, companies closer to the end customer are referred to as downstream companies, while those closer to raw materials are known as upstream companies. The management of a supply chain is facilitated by web information systems and tailored to the specific needs of the product involved. Generally, a supply chain consists of a cascade of companies operating in the same industry, from upstream to downstream. These companies include suppliers, manufacturers, distributors, retailers, and customers.

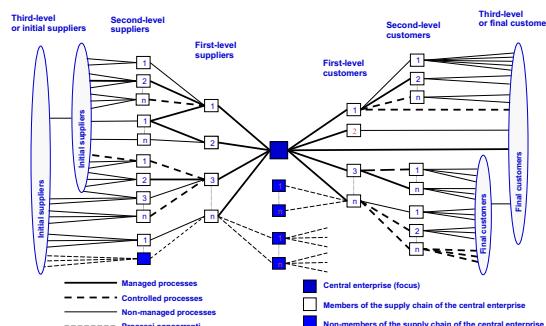
However, supply chains can be much more complex than this basic structure. They can involve multiple levels of suppliers and customers before reaching the final customers. Effective supply chain management involves coordinating with suppliers and customers to achieve a common goal: delivering the right product, at the right price, through the right intermediary, in the right quantity, to the right customers, at the right time.

Financial Impact and Positioning

Supply chain management plays a crucial role in driving revenues and profits for companies. The amount of money that companies can make along the supply chain is directly influenced by effective supply chain management. However, the financial impact and positioning of a company within the supply chain can vary depending on its position and the nature of the product.

While it is generally believed that companies closer to the customer, downstream in the supply chain, tend to make more money, this is not always the case. The profitability of a company depends on its strength within the supply chain. This strength is determined by factors such as bargaining power and the level of competition at that particular point in the supply chain.

Realistic View of Supply Chains

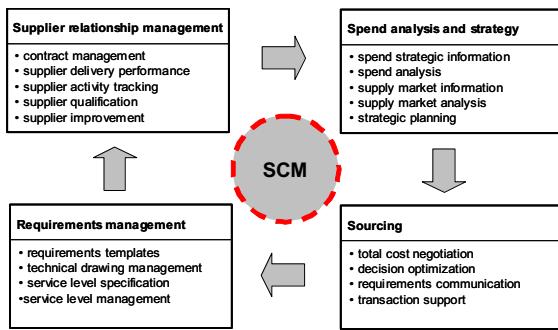


A realistic view of a supply chain involves multiple companies operating along the same chain. In this diagram, the blue squares represent these companies. For example, manufacturers within the supply chain may

compete against each other while also sharing suppliers and customers. They compete to attract the attention of customers and suppliers, ensuring they receive products at the right time to serve their customers effectively.

Supply Chain Management Process

Continuous Learning Cycle



Managing the supply chain is an ongoing process that requires continuous learning. Companies must constantly strive to improve their ability to manage the supply chain, as the world is constantly changing. This continuous learning cycle allows companies to adapt and stay ahead. The learning cycle is a repetitive process that ends at a certain point, but then starts again when something changes and new knowledge needs to be acquired.

Spend Analysis and Strategy To gain a better understanding of their supply chain, companies need to go through a learning process when introducing a new product. The first step in this process is spend analysis and strategy. This involves examining how money is being spent and determining if it is being allocated in the most effective way. Typically, the Pareto law is applied at this stage. Companies evaluate their suppliers and the materials they purchase, ranking them based on the amount of money spent. Ideally, this ranking follows the Pareto principle, where 20% of the materials or goods account for 80% of the spending. By focusing on optimizing this 20% of purchases, companies can achieve 80% of the benefits, as it covers the majority of their spending. This is the essence of spend analysis.

Supplier Assessment and Sourcing In the supply chain management process, the first step is to assess the supply market and determine if the company is purchasing from the best suppliers. This involves creating a list of suppliers and evaluating their position in the market. Strategic planning is then done to determine if any suppliers should be replaced with better

options. The company may also consider experimenting with new suppliers who are market leaders.

Once the best suppliers have been identified, the next step is sourcing. This involves negotiating the total cost with potential suppliers. The company approaches the supplier and discusses the amount they currently spend on the type of goods or materials provided by the supplier.

Requirements Management In our supply chain management process, one of the key steps is spend analysis and strategy. Each year, we analyze our spending and develop a strategy based on that information. As a supplier, if you can offer us a discount or integrate our information systems, it would make it more convenient for us to work with you. For example, if we have access to your stock levels, we can place orders with confidence, knowing that you can meet our requirements in a timely manner. We also prioritize electronic transactions to ensure accuracy and efficiency.

In some cases, we may even reach a point where we have automated processes, such as automatic order placement through MRP (Material Requirements Planning). Of course, this would only be possible if the supplier has the capacity to fulfill the orders.

Another important aspect of our relationship with suppliers is managing new requirements. The market is constantly changing, and we need to adapt to the evolving needs of our end customers. We work closely with our suppliers to address these requirements together. We value flexibility and the ability to respond to emerging needs, rather than rigid standardization. This collaborative approach allows both parties to continuously grow and stay competitive in the market.

In fact, our relationship with suppliers can be so strong that we even collaborate on designing new products or services together. This level of partnership and cooperation is what we aim for in our requirements management process.

Supplier Relationship Management In order to effectively manage supplier relationships, it is important to focus on step number three: requirements management. This step should be reserved for suppliers who have proven their loyalty and ability to support your business. By concentrating your purchases with these dependable suppliers, you can establish a strong working relationship over time.

However, it is crucial to recognize that suppliers may close, be sold, or acquired by other companies, regardless of their loyalty. In such cases, it becomes necessary to find new suppliers who can meet your requirements. To ensure a smooth transition, it is essential to engage

in supplier relationship management.

Supplier relationship management is similar to a CRM package, but specifically designed for suppliers. It provides a platform where suppliers can access a workspace, download contracts and RFPs, participate in tenders, and receive notifications about upcoming opportunities. They can also manage their contracts, payments, and undergo continuous evaluation and qualification processes.

By actively managing supplier relationships through this system, suppliers have the opportunity to grow and improve their performance. Positive evaluations can give them a competitive edge in future tenders, ensuring a mutually beneficial partnership.

Technology in Supply Chain Management

In addition to attending courses online, companies can also provide training programs for their suppliers. Through e-learning platforms, suppliers can access courses and gain knowledge about the company's needs before being approached for new projects. This allows suppliers to grow and improve their capabilities, making them more suitable for collaboration with the company. Certification and qualification processes further ensure that suppliers meet the company's standards.

All of these processes are managed through technology, which includes analytics, spend analysis, and strategy. The negotiation phase involves sourcing, and requirements management is done collaboratively. Transaction support is provided through e-commerce, and as the relationship with suppliers develops, the platform evolves to include CRM-like features for managing supplier relationships. This comprehensive technology platform enables efficient and effective collaboration between companies and their suppliers.

Social Media - I Lecture

Hello! Welcome to the first part of our lesson on social media. Now, let's get started. I will be sharing my screen with you and recording this session for your reference.

There is contamination between real-life social relationships and the networks of relationships on social media:

- social media create new social relationships (e.g. indirect contacts through LinkedIn)
- social media change existing relationships (e.g. dropping a fiancé by changing status on Facebook)
- social media change the time frame of social relations (e.g. keeping track of past work relationships with LinkedIn connections)
- social media reduce the barriers of knowledge sharing (e.g. Slide share) and, thus, reduce the kloot of knowledge holders
- overall, social media make social relationships easier, reduce the importance of knowledge holders and increase the importance of content

Defining Social Media

Web 2.0 and User-Generated Content

Social media are Web 2.0 sites, i.e. sites that support any form of sharing of user-generated content by leveraging the social relationships among individuals.

The extent to which social media leverage social relationships can vary from pure sharing of interests (e.g. YouTube channel) to a form of interaction among actual friends (e.g. Facebook).

Let's start by defining social media. Social media refers to Web 2.0 sites, which are distinct from traditional websites. In Web 1.0, companies primarily had institutional sites, as discussed in our Web information systems classes. However, Web 2.0 sites enable users to share various forms of user-generated content. This user-generated content is the key differentiating factor of Web 2.0 sites.

Social Relationships and Media

Social media platforms rely on user-generated content, which they obtain by leveraging social relationships among individuals. This can be done in two ways. Firstly, platforms like Facebook and Meta establish connections between individuals who are already friends in the real world. Secondly, platforms can also be based on shared interests, where individuals who may not have a real-world relationship still engage with the same content, such as watching the same YouTube channels. These shared interests serve as the basis for using the same social media and Web 2.0 sites.

Real World and Social Media Interactions

The integration of real life and social media is a two-way process. Social media platforms like Facebook not only leverage existing real-world relationships but also have the ability to create new connections. For example, people can become friends on Facebook through mutual acquaintances and then develop genuine friendships in the real world. This demonstrates how social media can bridge the gap between virtual and physical interactions, allowing for the formation of meaningful relationships beyond the digital realm.

Professional Networking on LinkedIn

In the professional world, LinkedIn is a valuable tool for accessing your contacts and even indirect contacts. When you connect with someone on LinkedIn, it means that you have worked together in some capacity at some point in time. Indirect contacts refer to the colleagues of your colleagues. For example, if you have worked with a person who has also worked with someone else, you may be interested in getting in touch with that indirect contact. In this case, you can ask your direct contact to introduce you to that person, and if all goes well, you may end up connecting on LinkedIn.

Impact of Social Media

Changing Nature of Relationships

Social media has a significant impact on the nature of relationships, both by creating new connections and by transforming existing ones. For instance, platforms like LinkedIn allow professionals to form new social relationships based on their work experiences and collaborations. Additionally, social media provides a platform for individuals to announce important life changes, such as accepting a new job or leaving a current one. By posting updates or changing their status on social media, people can inform their network about these changes. This ability to share information publicly can reshape the dynamics of social relationships.

Knowledge Sharing and Barriers

Social media platforms like LinkedIn have revolutionized professional networking by allowing connections to be maintained and strengthened over long periods of time. Unlike real-world connections that may fade over time, connecting on LinkedIn ensures that the relationship remains intact for years to come. This means that professionals can stay updated on each other's career advancements and maintain a strong professional bond.

One of the significant benefits of social media, in general, is the reduction of barriers to knowledge sharing. Platforms like SlideShare provide a perfect example of this. SlideShare is a website where individuals can share their slides and content on various subjects.

This means that if someone has expertise in a particular area and has prepared slides on that subject, they can share their knowledge with others. This allows people to access valuable content on new subjects without any barriers and at no cost. It eliminates the need to buy books or visit libraries, as all the information is readily available at their fingertips.

Overall, social media platforms have transformed the way professionals connect and share knowledge, making it easier and more accessible than ever before.

Quality of Content and Knowledge Holders

Since clout on social media depends very much on content, social media tend to care about the quality of content and invest in keeping it clean and dependable (e.g. wikipedia).

In general, if something is on social media, we take it as «true».

In general, the source is not considered enough to guarantee that content is true. People trust social media content thanks to the «wisdom of the crowds». If something is not true, somebody would know it and tell the community.

The impact of social media on the quality of content and knowledge holders is significant. One of the drawbacks is that social media platforms lack control over who can publish content, resulting in a reduction in the reliability of knowledge holders. It is common to come across material on social media that contains incorrect information, perpetuating and spreading these errors. So, when can we trust the material available on social media? The answer lies in conducting thorough research and cross-referencing information shared by multiple authors across various social media platforms. If there is a consensus among these sources, it indicates a consolidated body of knowledge that can be trusted.

In the past, having a slide set on a particular subject might have been seen as a sign of expertise. However, in the age of social media, this is no longer the case. The focus has shifted from the source of the content to the quality of the content itself. Social media platforms have made it easier to establish social connections, but they have also diminished the importance of knowledge holders. On these platforms, there is a mix of both good and bad content. While we may not always know the identity of the knowledge holder, we can still consume and appreciate high-quality content without necessarily paying attention to the creator.

Professional Implications and Content Creation

The impact of social media on the professional world has been significant. One major change is that established knowledge holders now need to prove their ability to produce high-quality content. Simply being a knowledgeable source is no longer enough; they must demonstrate their expertise through the content they create. This has led content creators to invest in main-

taining the quality of their information, and social media platforms also strive to ensure the cleanliness and reliability of the content they host. Wikipedia serves as a prime example of this effort.

While this is generally true, it is important to note that there may be exceptions. In some cases, social media platforms may not prioritize content cleanliness, and some knowledge holders may not put in the effort to produce good content. However, these cases are relatively rare, and the majority of social media platforms and knowledge holders do prioritize quality.

In the realm of social media, there is a general tendency to consider published content as true. This phenomenon is known as the “wisdom of the crowd.” The underlying idea is that if something is published on social media and is false, there are so many users with collective knowledge that one would expect someone to speak up and point out the inaccuracies. This confirmation of information on social media can sometimes be true. However, there are instances where people who disconfirm false information are not heard amidst the vast amount of content and discussions on social media. In these cases, the community is not made aware that certain content is inaccurate. Despite this, we still hold onto the belief that social control, which exists in the real world, also applies to social media. Therefore, if something is not disconfirmed, it is often taken as true.

Social Media Categories and Dynamics

1. Content sharing (videos(e.g. Youtube, Vimeo), pictures (e.g. Flickr), music (e.g. Napster) , knowledge (e.g. GoogleDocs, OS), experience (e.g. Yelp, or any feedback system))
2. Social networks (e.g. Facebook, Orkut ...)
3. Forums (moderated interactions, netiquette, evolution of bulletin boards and newsgroups, e.g. 4chan.org)
4. Blogs (personal blogs, corporate blogs, news blogs, political blogs, prison blogs ...). Platforms: blogspot, wordpress

Social media can be classified into various categories, including content sharing platforms, social networks, forums, and blogs.

Forums and Blogs

There are various types of content sharing websites and social networks that go beyond platforms like Facebook. These platforms allow users to share videos, pictures, music, knowledge, and personal experiences. While it is important to recognize the diversity of social sites, I want to emphasize the significance of forums and blogs.

When Facebook first emerged a few years ago, there was a belief that forums were becoming obsolete. People were encouraged to have a Facebook fan page and a personal blog, while forums were considered irrele-

vant. However, this assumption has been proven false. Many individuals continue to engage in both forums and blogs. These additional channels serve as complementary platforms, allowing people to express themselves and connect with others. As new social media platforms emerge, forums and blogs remain important to users.

It is crucial to remember that forums and blogs still exist and serve a purpose. In fact, they often provide highly specialized and high-quality information.

General Purpose vs. Specialized Media

In the world of social media, a general rule applies: if a platform is considered general purpose, it is likely to have a wide user base and cater to a broad range of interests. However, it's important to note that the quality of information on these platforms tends to be low, and you can only gain shallow knowledge on a subject. To acquire more in-depth information, specialized sources are available, but they often come at a cost.

Crowdsourcing Paradigm

Definition and Power of Crowdsourcing

Wikipedia – «**Crowdsourcing** is the act of sourcing tasks traditionally performed by specific individuals to a group of people or community (crowd) through an open call.

Crowdsourcing is a distributed problem-solving and production model.

Why is crowdsourcing powerful?

Because of the **wisdom of the crowd**.

The crowd sourcing paradigm refers to the practice of outsourcing tasks that were traditionally performed by individuals to a larger group or community, known as the crowd, through an open call. It is a new approach that involves distributed problem solving, production, and innovation with the help of a diverse group of people.

So, why is crowd sourcing so powerful?

Wisdom of the Crowd

Wikipedia – The **wisdom of the crowd** refers to the process of taking into account the collective opinion of a group of individuals rather than a single expert to answer a question.

Historical case:

The classic wisdom-of-the-crowds finding involves point estimation of a continuous quantity. At a 1906 country fair in Plymouth, eight hundred people participated in a contest to estimate the weight of a slaughtered and dressed ox. Statistician Francis Galton observed that the mean of all eight hundred guesses, at 1197 pounds, was closer than any of the individual guesses to the true weight of 1198 pounds. This has contributed to the insight in cognitive science that a crowd's individual judgments can be modeled as a probability distribution of responses with the mean centered near the true mean of the quantity to be estimated.

Let's look at some examples that illustrate the concept of the wisdom of the crowd. The wisdom of the crowd refers to the phenomenon where a group of indi-

viduals, who may not be experts, collectively provide a more accurate answer or prediction compared to individual experts.

The origins of the wisdom of the crowd can be traced back to an experiment conducted by a statistician at a country fair in 1906. In this experiment, the statistician asked a crowd of ordinary people, who were not considered experts, to guess the weight of an ox. After collecting their guesses, he calculated the mean value. He then approached a group of experts individually and asked each of them to make their own guess of the weight of the ox. Surprisingly, the mean value obtained from the crowd of non-experts was closer to the actual weight of the ox compared to the individual guesses of the group of experts. This phenomenon was termed the “wisdom of the crowd” and has since garnered significant attention.

While the concept of the wisdom of the crowd has been both broadly disconfirmed and confirmed in various cases over the years, it remains a fascinating area of study.

Business Examples and Effectiveness

The debate surrounding crowd sourcing is still ongoing, but the key point is that leveraging the collective wisdom of a crowd can yield results that are comparable, and sometimes even more favorable, than those obtained from a single expert. This approach has led to the emergence of numerous companies and businesses that have successfully embraced the crowd sourcing paradigm. While the following list is not exhaustive, it provides a glimpse of some notable examples. Crowd sourcing has become a highly effective model for accomplishing tasks in specific contexts.

Real-World Applications

- Amazon Mechanical Turk
- Wikipedia
- crowdSPRING
- Waze
- CloudCrowd
- CrowdFlower
- Kickstarter
- Stardust@home
- Distributed Proofreaders
- Wikimapia
- Threadless
- uTest
- OpenStreetMap
- Innocentive
- Google Answers
- Yahoo! Answers
- Digg
- Reddit
- Foldit
- BlueServo
- Cerberusgame
- Freelancer
- Get a Slogan
- TopCoder
- iStockPhoto

Waze is a prime example of highly effective outsourcing in the form of a navigation app. It optimizes the route for users traveling from point A to point B by leveraging real-time information on traffic conditions. By combining map data with up-to-date traffic information, Waze can guide users on the fastest and most efficient path, avoiding congested roads. This innovative approach has led to Waze's tremendous success,

- www.waze.com
- Born in 2009
- Over 10 M «wazers» in 2011
- Over 25 M traffic reports in 2011
- 4 million hour commuting time saved
- 25 million litre gasoline saved
- Acquired by Google in 2016



making it a global phenomenon in just seven years. In fact, its success caught the attention of Google, which eventually acquired the company.

Nike collects data from thousands of customers' finger taps on their smartphone displays and use it to collectively dictate what merchandise should be stocked in a new concept store in LA.

In this way, they hope to bridge the virtual and physical world.



In conclusion, crowd sourcing continues to be a valuable tool for companies like Nike. They have successfully implemented a collaborative crowd sourcing approach in their LA store, where customers can share their opinions and contribute to the development of new collections. Nike takes pride in this innovative approach and its success. This concludes part one, and we will now move on to part two.

Social Media - II Lecture

Welcome to part two of our class on social media. In the previous session, we discussed the concept of crowdsourcing and its application. To illustrate this, we used the Nike example.

Crowdsourcing and Co-Creation

Understanding Co-Creation

- Co-creation is a product/service innovation paradigm based on the cooperation between a supplier and the potential customers of the new product/service.
- Cooperation can be:
 - Direct, i.e. customer participation in the innovation process is deliberate (aware) and active.
 - Indirect: innovation occurs by taking advantage of the suggestions, comments, and opinions that customers provide in a variety of ways (call center, corporate site, social media...) without making them explicitly part of the innovation process (and related decision-making tasks).

Nike leverages the power of the crowd, which includes both potential and existing customers, to gather feedback, generate ideas, and shape new products and assortments. By utilizing crowdsourcing and co-creation, Nike aims to collaborate with its customers in the innovation process. Co-creation involves partnering with customers to define, create, and develop new products or services. This approach aligns with the principles of crowdsourcing discussed earlier.

Through co-creation, Nike gains valuable insights into sales priorities for its assortment and identifies emerging trends for new products. This innovative paradigm allows Nike to tap into the collective intelligence and creativity of its customer base, resulting in a more customer-centric approach to product development. By embracing co-creation and crowdsourcing, Nike is able to stay at the forefront of innovation in the industry.

Direct vs Indirect Co-Creation

In co-creation, the collaboration between a supplier and customers can take two forms: direct or indirect. Direct co-creation occurs when customers are aware that they are participating in an innovation process and actively choose to contribute. They understand their role in the process and willingly engage in it. On the other hand, indirect co-creation happens when customers are unknowingly involved in the innovation process. They may provide suggestions, comments, or opinions without being prompted by the company. The company can listen to these discussions on social media and use the inputs received to develop new products or services, even if the customers are unaware that their contributions are being utilized.

When companies are new to co-creation, they typically start with an indirect approach. They listen to the open and spontaneous discussions that customers have about their products and may gather feedback without explicitly informing customers that they are participating in a co-creation initiative. This initial step allows companies to understand customer perspectives. Once they have gained experience and confidence, companies can then move on to direct co-creation initiatives that explicitly require the deliberate participation of customers.

The Importance of Listening

- On social media, customers spontaneously provide suggestions, comments, and opinions.
- Listening can provide indications on all the inputs provided by customers that can be useful for product/service innovation.
- Listening is important in both types of co-creation, direct and indirect.

The importance of listening before engaging in direct co-creation lies in understanding what customers already think about your products. By starting with listening, you can gather valuable feedback that will guide the direction of your co-creation initiatives. Launching a co-creation project without prior knowledge of customer feedback may result in having to align your efforts with their expectations. Therefore, it is more beneficial to proactively seek out and analyze the spontaneous feedback customers provide on social media. This listening process not only helps in shaping co-creation initiatives but also provides valuable insights for product and service innovation.

Transitioning to Direct Co-Creation

- There exist success stories of both types of co-creation.
- Usually, indirect co-creation represents the first step (according to the «listen first» principle)
- A broad-range listening, outside of one's own community can help identify a few indirect co-creation initiatives useful to set clear goals for direct co-creation.

In simpler terms, companies can benefit from the comments and feedback that customers provide voluntarily and for free. This information can be used to design new products and services or improve existing ones without explicitly launching a co-creation initiative. Once the company is ready, they can then transition to direct co-creation.

Expanding the Scope of Co-Creation

Beyond Private Communities

Now, let's talk about indirect co-creation. To expand the scope of co-creation, it's important to listen not

only to the community within the company's private label community but also to the wider community outside of it. Let's use Vodafone as an example. Vodafone has its own private social platform called Vodafone Lab, where they listen to what their customers have to say. However, this platform is limited to customers who are already positive about Vodafone and remain loyal to the brand. As a result, the feedback they receive may not include the main reasons why other customers choose to leave Vodafone or why they choose a different provider. Therefore, it's crucial to have a 360-degree approach to listening, not just limited to your own clients. Companies often focus solely on their existing customer base, but this can be a limitation when it comes to gathering valuable insights.

Leveraging Influencers

To launch successful co-creation initiatives, companies need to address the challenge of motivating people to participate. Crowdsourcing, which is the basis of co-creation, relies on the crowd performing tasks that require time and effort. However, simply relying on the company's brand or reputation may not be enough to attract participants. This is where leveraging influencers becomes crucial.

Companies can identify influencers in the industries they operate in and collaborate with them to drive co-creation. Influencers, who are opinion leaders in their respective fields, have a strong presence on social media and can help generate interest and engagement. The advantage of working with influencers is that they are motivated by financial incentives. By compensating them for their contributions, companies can ensure their active participation in co-creation initiatives.

Paying influencers not only guarantees their involvement but also allows companies to tap into their expertise and leadership within their tribes. This approach provides a win-win situation: influencers monetize their position and companies benefit from their valuable insights. Additionally, influencers will share their opinions on social media, further amplifying the reach and impact of the co-creation initiative.

Designing Effective Co-Creation Initiatives

A fundamental risk of co-creation initiatives is to assume that customers will be happy to cooperate and will contribute to the initiative just because they are provided a chance to do so.

Contribution should be encouraged and coordinated with a careful design of co-creation initiatives.

In addition to running co-creation initiatives limited to influencers, companies can also make an effort to involve their entire customer base. The goal is to engage

influencers, compensate them for their participation, and rely on them to spread the co-created products to a wider audience. Paying influencers to promote the products increases the chances of influencing the crowd, as there have been many success stories in this regard.

Checklist:

- Participation mechanisms
- Technology platform
- Roles and tasks of community members
- Types of users in the community
- Incentive systems and rewards
- Quality control mechanisms

However, the main risk of expanding co-creation initiatives beyond influencers and involving direct client participation is the lack of effective encouragement and coordination of contributions. There is a possibility that clients may not contribute as expected, resulting in a failed initiative. To mitigate this risk, there is a checklist of design variables for co-creation initiatives. This includes determining the participation mechanisms, selecting the appropriate technology platform, defining precise roles and tasks for community members, identifying the types of users to involve, establishing an incentive system to motivate participation, and implementing quality control mechanisms to ensure high-quality content.

Co-creation initiatives are like creating a small social network, and it is crucial to prioritize the quality of content. The content itself is more important than the content creator. Therefore, low-quality content should be discarded, and the co-creation initiatives should be properly moderated and coordinated.

Marketing and Communication Strategies

Traditional Marketing and Broadcasting

Marketing is defined as «market orientation». It involves sensing market requirements to respond with organizational flexibility.

Traditionally, the first step of marketing was to make an organization's products and services known to the market, as a necessary action to stimulate feedback. Unfortunately, this communication has been found to be very effective also to drive the market especially through broadcasting. As a consequence, traditional marketing is often equated to advertising and there is always the idea that you can both sense and drive the market.

The checklist provided here goes beyond the traditional knowledge that marketers typically possess. Marketing is often defined as having a marketing orientation, which means understanding and responding to existing market needs. However, throughout history, companies have also been able to influence the market by investing in marketing initiatives. By allocating sufficient resources, companies can create a demand for a new product or service that may not have existed before. For example, a fashion designer with a new idea must create awareness and generate interest in their

product through marketing efforts. Marketing is not just about responding to existing needs; it's also about sensing a need, creating awareness for that need, and then responding to it. In essence, marketing involves both sensing and driving the market.

Traditionally, companies have used broadcasting as a means to achieve this. Broadcasting refers to the company speaking through a channel that reaches a wide audience simultaneously, such as television. For instance, a company designs an advertisement and broadcasts it on TV during prime time, when the audience is at its broadest. The audience receives the content but does not have the opportunity to respond directly. This form of communication is one-way, with the company broadcasting its message to potential clients.

Social Media Communication

Broadcasting vs. communication

In broadcasting, one broadcaster makes a content simultaneously available to many listeners (the audience).

In communication, all players are both broadcaster and auditors at different points in time.

Communication involves the ability to «listen». In communication processes, each one of us expects to be listened to at some point in time.

There is a distinct difference between broadcasting and social media communication. Unlike broadcasting, where only the broadcaster has the opportunity to speak, social media allows both the audience and the broadcaster to engage in conversation. While they may speak at different times, it is essential that both parties have the chance to express themselves.

Social media platforms serve as communication channels, enabling the audience to actively participate. Users can respond to content and leave comments, fostering a two-way interaction. In the field of marketing, there is a well-known distinction between “above the line” and “below the line” strategies. “Above the line” refers to broadcasting, while “below the line” encompasses social media communication channels.

Viral Marketing and Influencers

On social media, marketing is «viral», i.e. it takes advantage of the ability of all users to become broadcaster.

If each of us can broadcast with 500 people simultaneously, in three hops over 100 million users are reached.

However, people are free to choose whether to broadcast or not at all hops.

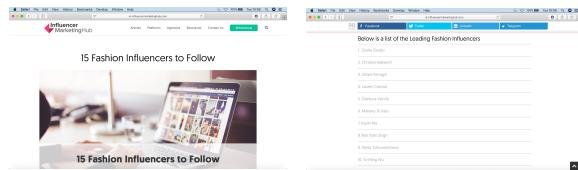
In marketing, there is a clear distinction between below the line and above the line strategies. When something is successful on social media, it can easily

be broadcasted to a wider audience. However, the reverse is not true. Content that performs well on traditional broadcasting channels may not be suitable for social media, as it can attract negative comments from a vocal minority. These negative comments can have a detrimental effect on the brand and its reputation among the broader social audience.

On social media, there is a group of individuals known as “haters” who are particularly aggressive and negative in their comments. Their opinions can influence the perception of the broader audience, and there is no way to control or govern what they say. To counteract this, it is important to activate viral marketing on social media. This involves creating high-quality content that is suitable for the platform and does not incite hate or offense. While the reach of an influencer with 100,000 followers may not compare to a prime-time broadcasting channel with millions of viewers, viral marketing has the potential to reach hundreds of millions of users on social media.

Fashion influencers

- They are marketing hubs for word of mouth (*engagement*), <https://www.youtube.com/watch?v=nQqY3j8tbl>
- They are capable of attracting attention, but this type of attention is quick to get and quick to evaporate (the hype of a post is about half an hour from posting)
- They are more and more organized: see, for example, theinfluencermarketinghub.com



However, it is important to note that people have the freedom to choose whether or not to share content. To encourage sharing, the content needs to be viral and capable of generating word-of-mouth. This is where influencers play a powerful role. As tribe leaders, influencers have a loyal following who are more likely to share their content simply because it comes from someone they admire and trust.

Governance and Process in Social Media

The Virality and Volatility of Social Media

On traditional media, the number of readers represents a reliable proxy of the influence of articles (and related news, opinions, etc.). Is the number of followers a corresponding reliable proxy of influence on Twitter?

On traditional media, negative news receive more attention than positive news. Is it same on Twitter?

On social media, attention is fleeting and trends come and go in an instant. The pace is incredibly fast, with a massive influx of posts that quickly fade into obscurity. Take a look at this list of global fashion influencers. You'll recognize some familiar names. To succeed on social media, you need to continuously generate buzz and keep the word-of-mouth going. It re-

- On average, negative tweets seem to be more retweeted than positive ones. However, social networks have a general positive bias.
- However, the dynamics (i.e. speed) of retweeting seem to be independent of the sentiment carried by tweets.
- The volatility of tweets is a critical variable, as 80% of retweeting occurs within the first half an hour from posting.
- Having more followers increases the probability of being retweeted, especially for negative opinions. However, about 40% of retweeting is performed by non-followers.

efforts should be made behind the scenes to address and mitigate any negative feedback.

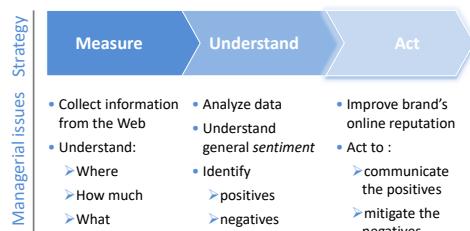
In the next part, we will discuss the technologies that companies can utilize to drive this governance process.

quires endurance and stamina to consistently produce engaging content in the hopes of it going viral. Interestingly, negative news tends to attract more attention than positive news in traditional media. The question is, does the same hold true for social media? The answer is yes. Even on social media, negative content tends to be retweeted more than positive feedback and posts. This is why haters often take the easy route. However, it's important to note that tweets have a short lifespan, with 80 percent of retweets occurring within the first 30 minutes of posting. Timing is everything in this fast-paced environment.

Governance Process for Companies

The Process

Strategy to manage a brand's online reputation



Measure To establish governance for social media, companies should follow a specific process. The first step is to listen, measure, and collect information. This involves understanding where people are talking about their brands, the volume of conversations, and the content of those conversations.

Understand The second step is to analyze the data in depth and determine the overall sentiment of people towards the brand. It is important to identify both positive and negative feedback. This analysis provides a summary of what is being said on social media and helps inform future improvements through knowledge management.

Act The third step is to take action. Companies should work on improving their online reputation by consistently communicating on social media, highlighting the positive aspects of their brand. Additionally,

Social Media - III Lecture

Social CRM Technology

Definition and Tools

Social CRM usually starts in one of the following ways:

- Hosting and supporting a branded or private-label community and providing the surrounding functions
- Monitoring, listening-to and surveying private-label or independent social networks
- Facilitating the sharing of common B2B or B2C contacts through the use of an internal community
- Community product reviews to facilitate the online sales process

Social CRM technology refers to the tools and systems that companies can utilize to effectively manage their presence on social media platforms. It is an extension of traditional customer relationship management (CRM) that incorporates social functionalities. These tools are specifically designed to handle the unique challenges and opportunities presented by social media.

Unlike traditional CRM systems, social CRM tools are tailored to manage interactions and engagements on social media platforms. They enable companies to monitor and analyze social media conversations, track customer sentiment, and respond to customer inquiries and feedback in a timely manner. These tools also provide valuable insights into customer behavior and preferences, allowing companies to personalize their interactions and deliver targeted marketing campaigns.

Some popular social CRM tools include social listening platforms, social media management systems, and social analytics software. These tools help companies streamline their social media management processes, improve customer engagement, and enhance their overall social media presence.

In summary, social CRM technology offers companies the means to effectively manage their social media presence and engage with customers on these platforms. It complements traditional CRM systems by incorporating social functionalities and providing tools specifically designed for social media management.

Community Support and Management

In the realm of social CRM, large companies often begin by supporting a private label community. This can take the form of a Facebook fan page or a community built around a mobile app. The next step is monitoring. This involves listening to and surveying both private label social networks and independent social networks to expand the reach of listening to potential clients. Once the community is established, companies can use various tools to activate the community, encourage content sharing, foster a sense of community,

and ultimately obtain product reviews and facilitate online sales. However, managing these interactions can be challenging, which is where social CRM comes in to assist.

Functionalities of Social CRM

Typical social CRM user functionalities

- | | |
|---|--|
| <ul style="list-style-type: none">• Discussion forums• Message boards• Comments• Polls and voting• Surveys• Reviews• Ratings• Chat• Blogs• Wikis | <ul style="list-style-type: none">• Bookmarking• Tagging• Search |
|---|--|

User Functionalities Social CRM technology offers a range of user functionalities that are primarily used by a company's internal users, such as marketing employees. These functionalities include discussion forums, where marketing employees can act as moderators, message boards, polls, and voting. These features allow companies to engage with their client base and gather feedback on preferences, such as product changes or color options. Additionally, social CRM provides functionalities for reviews, ratings, chat management (including the ability to save conversations), blog management, and wiki management. These various functionalities contribute to the comprehensive capabilities of social CRM technology.

Typcal social CRM administrative functionalities

- | |
|---|
| <ul style="list-style-type: none">• Moderation• Reputation management• Dashboards• Reports• Events management• Privacy management• Video management• Outbound campaign functionalities |
|---|

Administrative Functionalities In addition to the various functionalities of social CRM, there are also several administrative functionalities available. These include moderation, reputation management, dashboards, reports, events management, privacy management, video management, and outbound campaign functionalities. It's important to note that these administrative functionalities are primarily intended for internal use within the organization, specifically for administrative purposes. On the other hand, when we refer to the users of polls and voting as internal employees, it means that they have the ability to set up these functionalities for external users to utilize.

In addition to traditional CRM, social CRM also

offers outbound campaign functionalities. Just like in traditional CRM, campaign management is a key feature of social CRM. Companies frequently manage campaigns on social media platforms. One of the benefits of using social CRM is the ability to manage multiple social media platforms from one integrated dashboard. For example, companies can create content, compose a post, and then publish it on multiple social media platforms simultaneously.

Social CRM vs. Listening Platforms

Social CRM vs. listening platform

- Social CRM performs listening through surveys, direct interaction, manual monitoring (e.g. fan pages)
- Listening should be broader and include posting from non-members of private-label networks (e.g. non-fan)
- Listening should help understand a brand's competitive position, strengths and weaknesses
- Listening is technically challenging, as it involves the semantic understanding of natural language

Integration and Differences

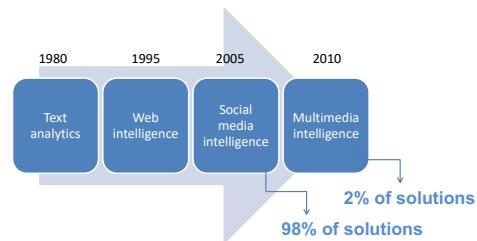
In the field of marketing, there are various tools that marketing employees need to use. For example, when managing campaigns, they may use social media platforms like Facebook, blogs, private label social networks, forums, and more. If these platforms are owned and managed by the company, they can utilize social CRM. However, when it comes to budget administration and reaching potential clients on social media to drive traffic to the company's website or encourage app downloads, they need to use the dashboards and applications provided by different global social media platforms such as Facebook and Google Ads.

One challenge with CRM is that the management of outbound campaigns on the web and social media lacks integration. Companies are still waiting for a tool that can integrate the management of all these channels into one platform. It's important to note the distinction between social CRM and listening platforms. While social CRM may or may not integrate a listening platform, it can perform surveys and interact directly with clients or potential clients. However, it may not be able to collect spontaneous information from social media and provide a summary of the main drivers of conversation or the sentiment surrounding different aspects of their products. Listening is a crucial first step, and many companies use a separate tool for this purpose, different from social CRM.

Examples of Listening Platforms An example of a listening platform is Nielsen Buzzmetrics. This platform specializes in collecting information from social media related to a specific brand or set of keywords.

It then generates a comprehensive report based on this data.

Evolution of the Market



From 2014, traditional software vendors have started to integrate social media intelligence.

Many companies choose not to handle social media monitoring in-house and instead opt to hire consulting firms. These firms utilize multiple listening platforms to gather data from various sources and provide an integrated view of a company's reputation on social media. The market for social media intelligence has evolved over time, progressing from simple text analytics to web intelligence and then to social media intelligence in 2005. After 2010, the market further expanded to include multimedia intelligence. Since 2014, traditional software vendors have begun integrating social media intelligence into their tools. However, it is worth noting that the best tools for social CRM are often separate from traditional CRM systems. In many cases, companies use a different tool for social CRM compared to their traditional CRM tool.

Data Sources and Analytics

Challenges with Data Sources

- Most platforms state that they crawl «the Web» or «all the Web»
- They provide a generic list of sources, typically: «blogs, forums, news, social media»
- Most of them (90%+) include Facebook and Twitter among their sources

When it comes to data sources, it's important to consider the vastness of the web. While tools for listening claim to survey the web in general, they may not effectively distinguish between institutional websites and social media platforms. These two types of sources are fundamentally different. Institutional web refers to official news sources and company websites, while social media includes platforms like Facebook, Instagram, and Twitter.

It's crucial to recognize this distinction because the institutional web does not necessarily represent the potential client base. Therefore, it's necessary to survey and understand these sources separately, as well as manage them independently.

One common issue with listening tools is that they can be misleading. In some cases, these tools may not provide an accurate list of sources, focusing only on social media and excluding the institutional web. They may also claim to survey a wide range of sources, such as blogs, forums, news, and social media in a generic manner. However, this generic approach can lead to varying indications of a company's reputation when different tools are used. This inconsistency is a pervasive problem in these types of applications.

Sentiment Analysis and Precision

Quality of results

- Lowering recall is considered an «intelligent» way to increase precision
- Precision is typically 1) not assessed 2) assessed on a single type of analysis
- No platform provides an overall assessment of precision calculated as:



In addition to lacking insights, these companies also apply very little intelligence to the information they receive. For instance, they fail to provide data on the precision of their tools. To illustrate this point, let's consider the example of sentiment analysis, specifically regarding people's opinions on the health impact of Nutella, one of Ferrero's brands. To accurately analyze sentiment, it is crucial to correctly identify the brand, categorize the posts based on topic, and assess whether people are discussing health issues. For example, if a client says, "I wasn't feeling good yesterday, but a spoonful of Nutella cheered me up," how should this post be interpreted? Well, it conveys a positive sentiment towards Nutella and does not discuss health concerns. This is not the desired outcome.

Typically, companies provide separate precision results for brand identification, categorization, and sentiment analysis. However, when these three dimensions need to be executed consecutively and accurately, the overall precision is typically the product of the individual precisions. This means that even if each dimension has a precision of 0.7 (70%), the overall precision becomes like tossing a coin, resulting in a 50% precision for sentiment analysis. In other words, the information obtained, especially regarding sentiment analysis, may not be accurate.

When companies fail to provide accurate data, it poses a problem. Reports without accuracy information may still be useful as they provide a general idea of the topics being discussed. However, sentiment analysis has not yet produced a standout application that justifies investing in the quality of results. The overall

quality of these analyses tends to be poor.

Future of Social Media Tools

Real-Time Services and Geolocation

- 75% of top platforms (Forrester sample) state that their service is real time
- Real time is not defined as an absolute metric, but is intended to be «quasi» real time (below 1 hour)
- Real time is not guaranteed for all sources
- Platforms do not specify whether real time applies to all data or only a subset

Another issue is the lack of real-time services offered by these companies. Many sources do not guarantee real-time updates and often have delays. In the context of social media, real-time should truly mean real-time. A 20-minute delay on social media is unacceptable, as the hype surrounding a topic can die down within half an hour. On the other hand, a 50-minute delay on news platforms like GDELT project by Google is acceptable, as news and institutional websites do not have the same dynamic nature as social media.

Industry-Specific Solutions

- 50% of top competitors (Forrester sample) provide analyses on geolocation
- 50% of top competitors (Forrester sample) provide benchmarking services based on the analysis of leading companies within selected industries

In order to make informed marketing decisions, it is crucial to have access to high-quality tools and information from reliable suppliers. This requires us to be knowledgeable and discerning in the market. Unfortunately, there are only a few tools available that provide geolocation information, which can be valuable for marketing purposes. Similarly, when it comes to benchmarking services that compare our company to industry leaders, only 50% of the existing tools offer this feature.

Vertical solutions (industry-specific)

- 50% of top platforms (Forrester sample) state that they provide vertical solutions in multiple industries
- Only 3 platforms specify the industries for which they provide vertical solutions (Nielsen, Attensity, Jdpower → they are all specialized in market analysis)
- None of them provides benchmarks on the amount of domain knowledge that they embed

However, there are numerous industry-specific solutions, also known as vertical solutions, that cater to specific sectors. For example, Nielsen Buzzmetrics are specialized in market analysis. When choosing a solution, it is important to consider the specific needs of our company and select the best vertical solution that

aligns with the requirements of our clients. By doing so, we can ensure that we have the most relevant and effective tools at our disposal.

Conclusion

In conclusion, the market for text understanding and information extraction is continuously evolving. While advancements like ChatGPT have made significant progress in this field, we are still awaiting the practical applications in this context. This concludes part three, which focused on social media.

Knowledge Management - I Lecture

Introduction to Knowledge Management

Good morning everyone! In this class, our main focus will be on knowledge management.

- Knowledge Management
 - What is knowledge?
 - Why do firms need to manage their knowledge?
 - Organizational strategies for KM
 - IT solutions for KM
 - Noticeable case studies

So, what exactly is knowledge management? It refers to the effective management of knowledge within organizations.

Defining Knowledge

- Knowledge that is used within an organization
- A state of the mind
 - "...a justified belief that increases an entity's capacity for effective action..." (Nonaka 1994)
 - Knowing: "...understanding gained through experience and study; the sum or range of what has been perceived, discovered, or learned." (Schubert 1998)
- An object
 - A thing to be stored and manipulated (Carlsson et al. 1996)
- A process
 - Knowledge is the process of applying expertise
- A capability
 - Knowledge is the potential to define and influence actions and to take decisions
- Data → Information → Knowledge
 - Information is raw data endowed with meaning
 - Information becomes knowledge when it helps in facing organizational issues
- Knowledge → Information → Data (Tuomi 1998)
 - Data may be forged only when people have knowledge to investigate facts in the environment

The concept of knowledge is multifaceted and has been extensively explored in literature. It can be defined in various ways, depending on the context. Knowledge can be seen as a state of mind, an object, a process, a capability, or even as the transformation of information into something practical that can solve real-world problems. The definitions of knowledge span across different disciplines, from philosophy to engineering and coding.

Knowledge Management in Service Companies

In the context of service companies, knowledge management plays a crucial role in improving service quality and personalization. It involves the collection, structuring, and transformation of information gathered during service operations into valuable knowledge for future activities. By effectively managing this process, service companies can maintain a strong relationship with their market and easily adapt to changing market requirements.

For instance, one question that often arises in knowledge management is how to embed company knowledge into software. This topic was initially introduced in the Business Information Systems (BIS I) course, specifically when discussing service companies. In this con-

text, knowledge management was defined as the process through which service companies gather information during their service operations. This includes interactions with customers and the completion of back-office operations to deliver services. The collected information is then structured and transformed into knowledge that can be utilized to enhance the quality and personalization of future service activities.

It is important to note that when knowledge management is effectively implemented, service companies can maintain a close relationship with their market. This enables them to adapt their services to meet new market requirements as they arise.

Evolution and Definitions in IT Context

A general underlying agreement

- Knowledge may come from the possession of information, data, but it is not restricted to them
- Knowledge is strictly tied to creativeness and the ability to contextualize general advice, expertise, best practices in a given situation
- Knowledge is strictly tied to "action" (making choices, learning about the environment, innovating,...)

In the context of knowledge management, knowledge is seen as a practical tool for companies. It allows them to give meaning to data and address organizational issues, especially in terms of continuous learning, managing new requirements, and adapting to market changes. The concept of knowledge management in service companies was initially defined in the mid-90s and has been periodically revisited as new technologies emerge. While there have been various definitions, when considering the application of information technology, there is a general consensus on a few key factors. Firstly, knowledge is closely connected to information and represents a transformation of that information, which itself is a transformation of data.

Knowledge Transformation and Practical Application

In the process of knowledge transformation, data is first collected and structured to obtain information. However, simply possessing information is not enough to guarantee knowledge within a company. Knowledge is derived from information, but it also requires the ability to transform that information into something useful. In the context of service companies, knowledge is closely tied to change and finding creative solutions to new problems. As the market evolves, companies must adapt and apply their knowledge in a creative way to solve specific problems in unique situations. It's important to note that this knowledge is not purely theoretical, but rather directly tied to action. The purpose of creating knowledge is to support actions, make informed choices, and drive innovation.

Taxonomy of Knowledge

Internal K

- Resides within the firm boundaries
- E.g., expertise, personal competencies, market and customers knowledge, technical skills

External K

- Resides outside the firm boundaries
- Organizations take specific actions to get this knowledge (e.g., hiring a consultant)
- E.g., Public agencies, Consulting firms, Internet, ...: they are all sources of external knowledge

Personal (individual) K

- Resides within the mind and the action of individuals

Organizational (collective) K

- Is specific of the organization and its culture, and internalized by its employees
- E.g., routines, best practices, methodologies for strategy and project management

Tacit K

- Knowledge that cannot be codified and which resides in the expertise/competences of people and groups of people

Explicit K

- Knowledge that can be codified in some sort of artifact (sw program, rules, document, ...)

Internal vs. External Knowledge

In addition to the principles we discussed earlier, it is important to understand the taxonomy of knowledge. This taxonomy helps classify different types of knowledge and provides a framework for leveraging knowledge to drive innovation. One key distinction is between internal and external knowledge.

Internal knowledge refers to the knowledge that exists within the boundaries of a company. It is the knowledge that the company possesses and has developed over time. On the other hand, external knowledge is knowledge that comes from outside the company's boundaries. This can be obtained through various means, such as hiring consultants or purchasing information from external sources.

For example, companies can hire consultants who bring their expertise and knowledge to help solve specific problems or provide guidance. They can also purchase information from information providers to gain insights and access to data that can be used for various purposes, including data monetization.

Understanding the difference between internal and external knowledge is crucial for companies to effectively utilize knowledge and drive innovation. By leveraging both internal and external knowledge, companies can tap into a wider range of expertise and resources to stay competitive and foster creativity.

Personal vs. Organizational Knowledge

Another important distinction in the taxonomy of knowledge is between personal and organizational knowledge. Personal knowledge refers to the knowledge that individuals possess in their minds. When working for an organization, the knowledge that an individual acquires and applies is their personal knowledge. On the other hand, organizations also possess collective knowledge. Organizations are created with the purpose of achieving specific objectives that no single individual can accomplish alone. This collective knowledge encompasses not only the sum of individual knowledge within the organization but also includes methodolo-

gies, strategies, best practices, and processes that the organization employs to achieve its objectives. It is the way in which individual knowledge is combined and utilized to solve problems and reach organizational goals.

The existence of collective knowledge in organizations is significant. It allows organizations to create value that goes beyond the capabilities of individual employees. By leveraging this collective knowledge, organizations can achieve outcomes that would be difficult to attain solely by hiring individuals. Additionally, the presence of collective knowledge ensures that if an individual leaves the organization, their knowledge can be replaced and the organization can still continue to pursue its objectives.

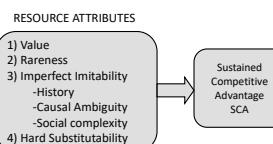
Tacit vs. Explicit Knowledge

In the taxonomy of knowledge, there is a clear distinction between tacit and explicit knowledge. Tacit knowledge refers to knowledge that is difficult to articulate or codify. It resides within the minds of individuals and is challenging to transfer to others. On the other hand, explicit knowledge can be easily documented and shared. For instance, one can write a book on a specific subject, but the readers cannot acquire the same level of expertise as the author.

This differentiation highlights the limitations of formal education, as there are certain aspects of knowledge that cannot be fully captured in books or taught in a classroom. However, companies make significant efforts to convert tacit knowledge into explicit knowledge whenever possible. This is done to ensure that if an individual leaves the organization, their knowledge can be easily replaced and transferred to new employees. The goal is to expedite the process of acquiring expertise for new hires and minimize any potential disruptions.

Knowledge as a Resource

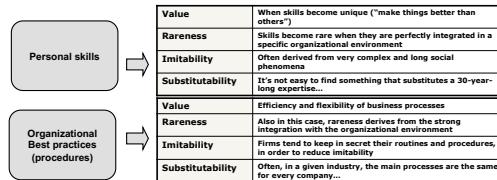
- The Resource-Based View of the firm: RBV
- The organization is a set of resources
- Some resources have the potential to become a source of sustained competitive advantage



Knowledge is a valuable resource for companies, as it can provide a sustained competitive advantage. The resource-based view of the firm (RBV) considers organizations as a collection of resources, with knowledge being one of them. The RBV theory aims to categorize resources and determine which ones are crucial for a company's success and competitive advantage.

When evaluating knowledge as a resource, it is important to consider whether it can be easily obtained from the market. If a certain type of knowledge is readily available for purchase, it cannot be a reliable source of sustained competitive advantage. While it may still be important, it is not a key factor in differentiating the company from its competitors.

- Most of the knowledge owned by a firm clearly shows the potential to adhere to the principles of the RBV theory in order to become a source of SCA
 - Value
 - Rareness
 - Low imitability
 - Low substitutability



The RBV framework is commonly used to rank and assess the resources of a company. It can even be used to evaluate the overall value of a company in the market. By examining the intrinsic value, rarity, imitability, and substitutability of the company's resources, including knowledge, one can determine their impact on sustained competitive advantage. A company with rare, difficult-to-replicate, and irreplaceable resources holds greater value.

A Sustainable Competitive Advantage (SCA) is a competitive edge that a firm can maintain over time by exploiting its unique resources and capabilities. It is a result of a firm's ability to use its resources and capabilities in a way that is not easily imitated or substituted by competitors. The RBV theory emphasizes that not all resources are of equal importance, nor do they possess the potential to become a source of SCA. The sustainability of any competitive advantage depends on the extent to which resources can be imitated or substituted.

In summary, knowledge is a valuable resource for companies, but its true worth lies in its rarity, imitability, and inability to be easily replaced by competitors. This can include unique personal skills or specialized organizational knowledge that is difficult to imitate or replace. Access to knowledge can even serve as a barrier to entry for competitors in a particular market segment. The RBV framework provides a useful tool for evaluating the importance of knowledge and other resources in achieving sustained competitive advantage (SCA).

Managing Knowledge

Complexity and Integrated View

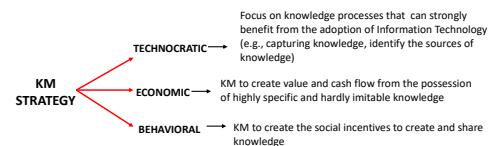
Managing knowledge is a complex task that requires an integrated view of the organization. It involves using information to improve the company's ability to

- Knowledge Management (KM) is a very complex issue
 - It's cross-divisional, enterprise-wide
 - It's primarily a management issue
 - Identify relevant forms of knowledge
 - Identify and cultivate **virtuous cycles** (and not **vicious cycles** of knowledge)
 - Create social incentives for sharing knowledge
 - Enable the knowledge sharing environment
 - It's boosted by IT tools: Knowledge Management Systems (KMS)
 - Costs / Benefits are not easy to be evaluated (see open issues)

achieve its objectives. This requires a cross-divisional and enterprise-wide approach, as discussed in BIS1. Creating virtuous cycles within the company, where information is used to generate new knowledge and drive growth, is a challenging but essential aspect of knowledge management.

Technocratic, Economic, and Behavioral Perspectives

- Different (theoretical) strategies [Earl 2001]
- Each KM initiative may be classified as a combination of strategies



Even as companies experience growth and innovation in their early stages, they often struggle to maintain this capability as they expand. This is why large corporations not only innovate internally but also acquire startups. It is challenging for them to maintain a constant flow of fresh ideas and motivate and reward innovators in a sustainable way. However, companies always strive to create social incentives for knowledge sharing, even if it is difficult. They want to ensure that individuals do not hoard knowledge but instead share it as much as possible, and they provide rewards for doing so. Knowledge management systems play a crucial role in facilitating this process. The main application of information technology in this context is to create an environment that encourages knowledge sharing and growth.

Managing knowledge can be approached from different perspectives: technocratic, economic, and behavioral. These perspectives are not mutually exclusive and are often used in combination. All three perspectives must be applied to effectively perform knowledge management in companies. The technocratic view focuses on how information technology can support knowledge processes. The economic view emphasizes evaluating and monetizing knowledge, as well as assigning and monitoring its value within the company. The behavioral view addresses how to manage and create social incentives to promote knowledge sharing and the continuous growth of organizational knowledge.

- Strong reliance on the adoption of information and management technology
- Capturing knowledge and make it available to other people in the firm
 - E.g., knowledge networks (post-reply mechanisms for problem solving)
 - Insurance companies: formalize techniques and algorithms for risk assessment and make them available to others (e.g., new employees)
 - Generally: project documentation sharing
- CSFs
 - Connecting people
 - Incentives for providing content to systems
 - Content validation (cultivate *good* content and discard useless contributions)

Technocratic Strategy

In the technocratic strategy, the focus is on technology and addressing the fundamental problem of capturing and sharing information to create knowledge. One key question is how to ensure that the necessary information is available to everyone. Formalizing techniques for risk assessment in insurance companies is an example of how knowledge can be captured and made accessible to others. Another example is the use of information technology tools like Slack, which facilitate cooperation, knowledge sharing, and keeping everyone updated on different issues.

Economic Strategy

- Protecting and exploiting the knowledge assets of the firm to generate cash flow and revenue streams
- The perspective of managing knowledge as an asset
 - Patents
 - Copyrights
 - Non-disclosure agreements
 - Intellectual property management
 - Trade secrets
 - ...
- CSFs
 - Create specialized teams/division for managing knowledge assets
 - Identify the relevant knowledge that may generate revenue

In the context of economic strategy, the focus is on managing knowledge as a valuable asset. This involves utilizing various mechanisms to protect knowledge within organizations, such as patents, copyright, NDAs (non-disclosure agreements), intellectual property management, and trade secrets. These tools ensure that knowledge remains safeguarded and secure.

Behavioral Strategy

- Communities of Practice (CoP): loosely knit teams of people that work on common issues and problems
- Give tools (organizational and IT-based) to CoP to support knowledge sharing and transfer
 - Large corporations: Create strong links between people with the same qualification within the organization (e.g., lawyers, sw developers, HR managers of different divisions)
 - Product development: create support to different people in the development of a new product (e.g., technical design, graphical design, marketing,...)
- CSFs
 - Identify relevant CoPs
 - Connecting people

Organizations often fail to protect the knowledge they create, despite recognizing its importance. They tend to prioritize and safeguard only the knowledge that contributes to their sustainable competitive advantage. From a behavioral perspective, the concept of a “community of practice” is crucial. Companies bring together individuals who face similar problems within the organization, regardless of their specific roles. These communities are formed to address com-

mon issues and work collaboratively. For instance, consulting companies often have shared repositories containing presentations, project templates, and examples of successful management.

creating a knowledge sharing culture

-
- Exploit the design of the company's space and structures to create the antecedents of knowledge sharing (knowledge sharing culture)
 - Shared spaces: water cooler, coffee makers, vending machines...
 - Open office spaces: remove the barriers among individuals
 - CSFs
 - Design of useful knowledge spaces
 - Encourage and legitimize people in sharing knowledge

However, it is important to manage these communities of practice effectively. Simply providing the opportunity for knowledge sharing does not guarantee that it will occur. The systems facilitating knowledge sharing must be positioned correctly, and individuals must be actively engaged to ensure that knowledge is shared. According to the principles of behavioral strategy, creating a culture of knowledge sharing is essential.

Knowledge Management - II Lecture

This is the continuation of the recording on knowledge management.

- Knowledge Management Systems (KMS)
- "...a class of information systems applied to manage organizational knowledge..., that is, IT-based systems to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application" [Alavi and Leidner 2001]
- Every organizational IT-based system may adhere to the definition...

Knowledge Management Systems

Behavioral Strategy for Knowledge Management

Knowledge Sharing Culture

Let's discuss the behavioral strategy for managing knowledge and creating a knowledge sharing culture. Companies have the power to shape their environment, both physically and culturally, to encourage knowledge sharing. One effective way to do this is by implementing shared spaces and open office layouts. These spaces remove barriers between individuals, allowing for better collaboration and communication.

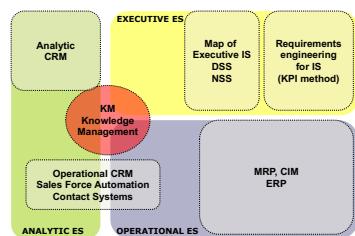
Open office spaces are particularly interesting because they provide an opportunity to observe and learn from others. By working in close proximity to colleagues, you can see what they are working on and hear their conversations. This allows you to build a mental map of who possesses specific knowledge and who is working on certain projects. Having this knowledge is invaluable because it helps you identify the right people to approach for input or assistance on specific issues.

Legitimizing Knowledge Sharing

Legitimizing knowledge sharing is a crucial aspect of knowledge management, especially in hierarchical organizations where sharing knowledge is often restricted. In such organizations, knowledge cannot be shared without the authorization of the person in a higher position or the one responsible for the specific unit. For instance, if someone from a different unit needs a report that you possess, you are not allowed to share it without permission.

To promote knowledge sharing in practice, it is essential to legitimize and change these strict hierarchical rules, at least for certain categories of knowledge. It is crucial for people to understand the rules and for the rules to clearly define what types of knowledge can be shared and what cannot. By establishing clear guidelines, organizations can encourage a culture of knowledge sharing and facilitate the flow of information among employees.

Knowledge management systems play a crucial role in facilitating knowledge sharing within organizations. These systems provide the necessary support for effective knowledge sharing. The definition of knowledge management systems is quite broad, encompassing various components of an Enterprise Resource Planning (ERP) system. In fact, almost all modules of an ERP can be classified as a knowledge management system or can be utilized as such.



The chart provided represents the modules of an organization's information system from a knowledge management perspective. Many of these modules align with the ERPs we have discussed previously. We may delve deeper into some of these modules in future discussions. The terms "executive," "operational," and "analytical" are familiar to us from our classification of ERP functionalities in BIS 1 and the early stages of BIS 2. The breadth of knowledge management systems can be somewhat disappointing from a technical standpoint, as we typically expect specific technologies to support particular applications. However, in the case of knowledge management, the scope is extensive. Even the definition of knowledge itself is broad. Therefore, any module within an ERP can be considered a knowledge management system or a part of an organization's knowledge management system.

Assessing Knowledge Management Success

1. Project-oriented evaluation
 - Growth of the resources attached to KM problems (people, money,...)
 - Reach of KM initiatives (number of offices, divisions,...)
 - KM project survival
 - Surveying people
 2. KMS-oriented evaluation (IT-intensive KM)
 - Usage of KMS (number of accesses, retrieved documents, KB extension,...)
 - Reach of the electronic community (e.g., number of people)
 3. Efficiency and financial evaluation
 - Reduced cycle time, number of claims, ...
 - Improved customer satisfaction, satisfied phone calls, ...
 - Evidence of financial benefits
- Generally, correlation between indicators in class 1 and 2
 - Financial indicators (when available!) often remain uncorrelated with the others...

Project-Oriented Metrics

The effective utilization of existing technology is crucial for the success of a knowledge management initiative. Assessing the success of such an initiative can be done from various perspectives, starting with a project-oriented approach. Companies often launch knowledge management projects, and evaluating their success involves considering factors such as the resources allocated to the project, the scope of the initiative (including the number of divisions or units involved), the number of people engaged, and the longevity of the project. These project-oriented metrics are particularly significant in the early stages of knowledge management initiatives, where the focus is on the project itself.

User Satisfaction and Feedback

As time progresses, it is crucial to assess the success of the knowledge management project. One way to do this is by conducting a survey to gather feedback from the individuals involved. Positive feedback is essential because it indicates that people are satisfied with the project. This satisfaction is important because individuals need to be willing to contribute their knowledge to the knowledge management system. If they are not happy, they are unlikely to provide any input or share their knowledge.

Technology and Usage Assessment

When assessing the success of knowledge management, companies often want to evaluate their technologies. They ask questions like: Do we have the right technologies in place? What technologies do we currently have? To determine the maturity of their information system from a knowledge management perspective, companies can conduct a survey and define the scope of their knowledge management system (KMS). They identify key functionalities within their ERP that are crucial for knowledge management and include them as part of their KMS.

In addition to assessing the technologies, it is important to evaluate the usage of the knowledge management system. Usage is a significant metric of success because if an application is not being used, it is clearly not successful. However, it is important to note that just because an application is being used does not necessarily mean it is successful from a knowledge management perspective.

Financial and Efficiency Evaluation

The success of a knowledge management system can be initially driven by extrinsic incentives, such as monetary rewards or the chance to win prizes. These incentives encourage people to use the system, resulting in high usage metrics that may indicate success. However, the true test of success lies in what happens when these incentives are removed. Will people continue to use the system?

When launching a new application or service, it is common to provide incentives to attract users and generate word-of-mouth promotion. But once the incentives are no longer available, the sustainability of the system becomes uncertain. It is important to consider the long-term usage and engagement of users beyond the initial incentive period.

To assess the success of a knowledge management system, it is crucial to look beyond simple usage metrics, such as the number of clicks. Instead, focus on the number of active users and contributors. It is essential to ensure that the number of contributions outweighs the number of downloads, indicating that people are actively using and benefiting from the system.

A balanced scorecard of metrics can provide a comprehensive evaluation of the success of knowledge management. This includes assessing factors like review cycle time, number of claims, customer satisfaction, and other financial benefits specific to the organization and its goals. By evaluating both the financial and efficiency aspects of knowledge management, a more accurate assessment of its impact can be obtained.

Challenges in Knowledge Management

IT-intensive KM often tends to fail, why?

- Complex inter-organizational processes: Governance problems
 - Who is going to be accounted for costs of the KM initiative?
 - How to assess the benefits of the KM initiative?
 - Who is going to be accounted for the benefits?
- Tendency to overestimate the power of IT tools for KM
- ...
- KMS often remain unused by intended users

High Failure Rate and Governance Issues

When evaluating knowledge management, it is important to consider multiple indicators rather than relying on just one. One significant challenge in knowledge management is the high failure rate of projects. The question then arises: why do these projects fail so frequently? The main reason is often a governance issue, indicating that the project was not properly managed.

Overestimation of IT Tools

One of the challenges in knowledge management is the overestimation of IT tools. Companies often assume that providing employees with the necessary tools is enough to ensure their usage. However, this is not always the case. Simply having the tools does not guarantee their effective utilization.

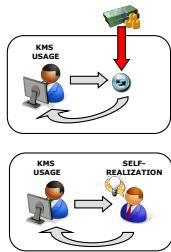
Another challenge is the lack of assessment and metrics to measure the benefits of knowledge management. Without proper evaluation, organizations may not be able to adjust their work direction to maximize the benefits of knowledge management.

Additionally, there can be governance issues, such as the absence of clear accountability and ownership for the knowledge management project. When multiple departments are involved, it is crucial to have a dedicated unit or individual responsible for driving the project forward.

These organizational and technological challenges can result in knowledge management tools remaining unused, despite their potential to enhance productivity and efficiency.

Balancing Extrinsic and Intrinsic Motivation

- External (extrinsic)
 - Prizes
 - Monetary rewards
 - Increased visibility
 - ...
- Internal (intrinsic)
 - Make System usage personally meaningful
 - Support self-realization of users



The challenge in knowledge management lies in finding the right balance between external and internal motivation. External motivation refers to the use of monetary rewards to encourage people to contribute knowledge to the system. This is often necessary to kickstart the process and ensure that the system has valuable knowledge to share. However, relying solely on external motivation can lead to issues.

- The typical consequence of external incentives:
 - Increase the number of contributions
 - Decrease the quality of contributions
- Need for continuous adaptation of incentive schema
 - “Incentive alignment”
- Many examples
 - Siemens ShareNet
 - InfoSys KShop
 - ...

When people are paid to provide knowledge, they may not contribute because they genuinely believe they have something valuable to share. Instead, they may simply provide whatever information they have to receive the monetary incentive. This results in low-quality content in the knowledge management system.

Users who download this content will be discouraged by its poor quality, leading to a lack of further engagement with the system.

To address this challenge, it is important to strike a balance between external and internal motivation. While external incentives can be effective in the initial phase of knowledge management, it is crucial to also foster internal motivation. Internal motivation comes from individuals who genuinely believe they have valuable knowledge to contribute and are driven by the desire to share it with their colleagues. By encouraging this intrinsic motivation, the quality of the content in the knowledge management system can be improved, leading to greater user engagement.

Finding the right balance between external and internal motivation is essential for creating a sustainable knowledge creation cycle. It ensures that contributions to the system are driven by both external rewards and the genuine desire to share valuable knowledge.

Strategies for Effective Knowledge Management

Activating the Knowledge Creation Cycle

To activate people's willingness to provide knowledge and be recognized for it, a voting mechanism can be implemented. This mechanism would assess the quality of the content provided by individuals, similar to the “likes” on Facebook. By receiving positive feedback such as likes, downloads, or questions from colleagues, individuals would be ranked higher in the knowledge management system, giving them a sense of authority and recognition in their field. Conversely, if the content does not meet a certain threshold of downloads or engagement, it may be removed from the system. The goal is for individuals to feel self-realized and authoritative based on the recognition they receive for their knowledge. By designing a management system that allows individuals to showcase their expertise and be acknowledged by their peers, they will be motivated to share high-quality content. This, in turn, will encourage others to download and engage with the content, creating a positive feedback loop.

Adapting Incentive Schemas

This chart highlights the importance of adapting incentive schemas for effective knowledge management. It emphasizes that external incentives often fail and provides examples like Siemens ShareNet that can be researched further. It also emphasizes the need for continuous adaptation of incentive schemas based on the project phase. This adaptation requires experience, which the company can gradually acquire over time.

Starting from a Need and Managing Projects Carefully

When it comes to implementing knowledge management, it's important to approach it strategically. Instead of assuming that people will automatically provide high-quality content, be vigilant and aware that this may not always be the case. To begin, identify a specific need or problem that can be addressed through knowledge management. This could be something that people have expressed a desire for or a topic that would benefit from shared knowledge. Once the need has been identified, manage the project carefully, ensuring that all aspects are well-planned and executed effectively. By starting from a need and managing the project with care, you can maximize the effectiveness of your knowledge management efforts.

In conclusion, it is important to minimize the reliance on external incentives as the primary motivation for knowledge sharing. While small incentives may be used initially, they should not be the sole driving force behind people's willingness to share knowledge. It is crucial to foster a culture where knowledge sharing is valued and encouraged intrinsically.

Big Data Analytics - I Lecture

Introduction to Big Data Analytics

Good morning, everyone. Today's class is focused on Big Data Analytics. Let me share my screen so you can follow along with the slides. Big Data Analytics is a widely discussed topic these days, and it's important to understand what it truly entails and the opportunities it presents for businesses. We will also explore how technology has evolved and how this evolution has shaped the applications of Big Data Analytics. To illustrate these concepts, we will examine a few case studies.

Defining Key Terms

- **Artificial intelligence** (AI, also machine intelligence, MI) is intelligence demonstrated by machines, in contrast to the natural intelligence (NI) displayed by humans and other animals.
- **Machine learning** (ML) is a subset of artificial intelligence in the field of computer science that often uses statistical techniques to give computers the ability to "learn" (i.e., progressively improve performance on a specific task) with data, without being explicitly programmed.

Artificial Intelligence

In order to establish a common vocabulary for this class, let's begin by defining some key terms. While many of you, as computer engineering students, may already be familiar with these definitions from previous courses, it's important to ensure that everyone, including management engineering and telecommunication engineering students, understands the terms we will be using.

First and foremost, let's define artificial intelligence (AI). AI refers to the intelligence exhibited by machines, in contrast to the natural intelligence displayed by humans and other animals. It encompasses the intelligence demonstrated by machines.

Machine Learning

Machine learning is a subset of artificial intelligence (AI), meaning that AI encompasses more than just machine learning. Machine learning is a specific type of AI where computers learn to solve problems based on data, without the need for explicit programming or pre-defined rules. This ability to learn and solve problems without code has made machine learning highly popular in recent years. It offers companies the opportunity to develop useful applications of information technology without the need for extensive coding. This is particularly appealing considering the shortage of skilled

computer engineers. Machine learning allows organizations to leverage the data they have collected over the years and apply it to various IT applications. While machine learning receives a lot of attention, it's important to remember that it is only a small part of the broader field of artificial intelligence.

Problems and Capabilities of AI

- **Capabilities** generally classified as AI include successfully understanding human speech, competing at the highest level in strategic game systems (such as chess and Go), autonomous cars, intelligent routing in content delivery network and military simulations.
- The traditional **problems** (or goals) of AI research include reasoning, knowledge representation, planning, learning, natural language processing (NLP), perception and the ability to move and manipulate objects.

Let me provide you with some examples of the common problems and capabilities associated with artificial intelligence (AI). Problems that AI aims to address include reasoning, knowledge representation, planning, learning, natural language processing (NLP), robotics for object manipulation, and perception for sensor development. On the other hand, the capabilities typically classified as AI encompass understanding human speech, competing in strategic games like chess and Go, autonomous driving, intelligent content delivery networks, military simulations, and many more. These examples only scratch the surface of the numerous applications of AI.

Classes of Machine Learning Algorithms

- **Unsupervised learning:** learning from data without a need for «ground truth», e.g. clustering or pattern recognition.
- **Supervised learning:** learning from data with «ground truth», e.g. predictive analytics.

«Ground truth» is data on the «true» behaviour or status of a system, typically obtained from direct measurement of real-world data.

In the field of machine learning, algorithms are typically categorized into two main classes: unsupervised and supervised. While there are also semi-supervised algorithms, for the sake of simplicity, let's focus on the distinction between supervised and unsupervised learning.

Unsupervised learning algorithms have the ability to learn how to solve a specific problem by analyzing the data, without the need for a predefined correct solution. On the other hand, supervised learning algorithms require a set of problem instances along with their corresponding correct solutions, which is known as the "ground truth." In supervised learning, algorithms need explicit feedback to determine whether they are solving specific instances of the problem correctly or incorrectly.

The ground truth, therefore, refers to the set of problem instances and their correct solutions that are used to train supervised learning algorithms. It serves as a reference for the algorithm to learn from and improve its performance. However, the reliance on the ground truth is one of the main limitations of applying machine learning in real-world scenarios.

Ground Truth and Its Importance

Obtaining ground truth can be a challenge for companies, as they may have plenty of data but lack the actual solution to the problem instances. The question then becomes how to collect the necessary ground truth. In most cases, the ground truth is obtained through direct measurement of real-world data. For example, if you need pictures of tanks, you can use a drone to capture those pictures, ensuring that they are labeled as tanks. However, collecting ground truth can be costly in terms of time and effort for companies. In some cases, the cost of collecting ground truth is so high that even though machine learning could be beneficial in theory, it may not be feasible to apply it due to the challenges associated with obtaining the necessary ground truth.

Case Study: Crop Classification

- Satellites provide images of the earth, divided in pixels (e.g. 30mx30m pixel size), represented as reflectance values
- *Unsupervised approach:* from reflectance values, it is possible to identify larger areas (e.g. fields) with clustering techniques. Larger areas are then labelled based on the reflectance footprint of different types of crop.
- *Supervised approach:* from a classification of pixels (ground truth) it is possible to predict the crop for next year by training a random forest on reflectance values of previous time period (e.g. last year's satellite observations with corresponding ground truth).

Let's consider the case study of crop classification in the context of earth observation. Satellites regularly capture images of the Earth, dividing them into pixels, each with its own color. The challenge is to determine the type of crop cultivated in each pixel based on its color. While machine learning algorithms can be used for this task, obtaining labeled data, or ground truth, is essential.

There are two approaches to obtaining ground truth. The first is supervised learning, where pixels are labeled with the corresponding crop type. This requires a significant amount of labeled data to train the algorithm effectively. The second approach is unsupervised learning, where pixels are grouped based on similarity. However, the crop type for each group is unknown. To assign labels to the grouped pixels, at least one pixel in the cluster must be observed and labeled.

While unsupervised learning can be performed without any ground truth, having some labeled observa-

tions is necessary to make the application useful. With supervised learning, a larger amount of accurately labeled data is required. However, the precision achieved with supervised learning is often superior to that of unsupervised learning.

Collecting ground truth for crop classification can be expensive and time-consuming, as it involves physically visiting fields to observe the crops. However, the benefits of accurate crop classification are significant. For example, in finance, crop classification can help make investment decisions based on projected crop availability and estimated prices. This information allows investors to determine whether and at what price to invest.

In conclusion, while collecting ground truth for crop classification may be costly, the value and usefulness of the application make it worthwhile. Accurate crop classification enables informed decision-making in various industries, such as finance.

In many finance-related applications, collecting the ground truth is essential because these applications generate significant revenue. There are professionals who specialize in collecting the ground truth for these applications. However, this is not always the case for all applications. Some applications may not generate enough revenue to justify the effort and cost of collecting the ground truth.

Deep Learning

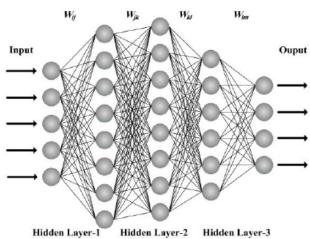
Deep learning is a class of machine learning algorithms that:

- Use a cascade of multiple layers of nonlinear processing units for feature extraction and transformation. Each successive layer uses the output from the previous layer as input.
- Learn in supervised (e.g., classification) and/or unsupervised (e.g., pattern analysis) manners.
- Learn from multiple levels of representations that correspond to different levels of abstraction, e.g. the levels form a hierarchy of concepts.

Now, let's move on to understanding what deep learning is. Deep learning is a specific subset of machine learning, which itself is a subset of artificial intelligence. In deep learning, algorithms consist of multiple layers of nonlinear nodes that process input data to produce an output, which represents the solution to a given problem. The input data describes the problem, while the output is the desired solution.

Each layer performs a different transformation, e.g. image recognition:

- Layer 1 Segment image in pixels.
- Layer 2 Aggregate pixels in areas to obtain a simplified image recognition problem.
- Layer 3 Train a (single) network to recognize image.



The diagram represents a multi-layer neural network, where each node represents a nonlinear function.

The network consists of input nodes, output nodes, and intermediate layers where the input data passes through nonlinear functions and is then forwarded to subsequent nodes. The final layer, in this case, is layer three, which generates the output. The nodes in the network have parameters associated with them, and during training, these parameters are adjusted to optimize the network's output with minimal error.

Neural networks are known to require a large amount of input data with known correct outputs for training. Considering the number of nodes, connections, and parameters in the network, it becomes clear why collecting the ground truth is a significant challenge. Many instances of problems with their corresponding correct solutions are needed to train the network effectively and find the best combination of parameters that produce the desired output.

Natural Language Processing (NLP)

- **Natural-language processing (NLP)** is an area of computer science and artificial intelligence concerned with the interactions between computers and human (natural) languages, in particular how to program computers to process and analyze large amounts of natural language data.
- **Challenges** in natural-language processing frequently involve speech recognition, natural language understanding, and natural language generation.

Evolution and Applications

There are various mechanisms and algorithms, such as one-shot learning, few-shot learning, and extreme machine learning, that aim to reduce the amount of input required to obtain the desired output. Additionally, strategies like ground truth augmentation and synthetic data can be used to make the most of limited instances or generate instances when none are available. However, these approaches are still the subject of ongoing research.

- 1990 – Document management (document classification and retrieval, topic extraction)
- 2000 – Document and Web search
- 2005 – Speech to text (Voxforge 2006-, Sfynx 2011-)
- 2010 – Social media analytics, Web reputation, sentiment analysis
- 2015 – (chat)BOTs

Moving on to natural language processing (NLP), it focuses on enabling humans and computers to interact using natural language, such as spoken or written language, without the need for humans to adapt to computer language. NLP has gained attention in various fields over the years. In the 1990s, it was primarily used for document management, classification, retrieval, and topic extraction. Around the year 2000, it expanded to include document and web search, exemplified by Google. In 2005, speech-to-text capabilities were developed. From 2010 onwards, NLP has been

applied to social media analytics, reputation management, sentiment analysis, and more recently, chatbots.

Despite these advancements, it is important to note that NLP is not yet a fully mature field. There are still many areas where further work is needed to ensure optimal performance. For example, sentiment analysis remains a challenging task, as there is currently no tool that can automate sentiment analysis with sufficient accuracy across different contexts.

Chatbots and Their Effectiveness

- A BOT works «for us», just like any other algorithm.
- The difference between a BOT and an algorithm is that a BOT does what we (humans) would do.
- For example, if we ask for the square root of a number, the BOT opens the calculator, digits the number, presses the square root button and then reads the result.
- The interaction with us is the best state-of-the-art interaction, initially based on text chats, now more often based on speech recognition.

In the realm of Natural Language Processing (NLP), there is still much work to be done for chatbots to reach their full potential. While there have been advancements in NLP over the past decade, even older applications require further development. Chatbots, in particular, are still in their early stages. To gain insight into what companies are currently doing in this field, you can watch the video provided in the link on this slide.

Currently, our experience with chatbots is limited in terms of NLP capabilities. Ideally, in NLP, we should be able to interact with chatbots through speech or written text, and they should understand and provide relevant answers. However, most chatbots today initiate the conversation by asking questions, guiding users through a predefined interface with buttons to press. This approach does not effectively address the user's specific problem or needs. In my opinion, these chatbots are not very effective.

If you start asking questions and the chatbot fails to provide immediate answers or if you express dissatisfaction, it is possible that a human operator will intervene. The system recognizes when the chatbot is not effectively interacting with the user and prompts a human to take over. This approach is similar to the concept of call centers, where automation directs queries to the appropriate operator and handles common questions. If automation fails, a human operator steps in. It's important to note that in most cases, we are not referring to chatbots that can understand spoken language.

In the early days of chatbots, there was not even an interface to indicate that user input was required. Users were allowed to start asking questions right away, but unfortunately, the chatbot often provided incorrect answers. Even if the user asked a common question that the chatbot should have been able to answer,

the challenge lies in understanding the user's specific phrasing. There are countless ways to ask about the opening hours of a shop, for example, and the chatbot must be able to extract the meaning regardless of the specific wording. However, we are still far from achieving this level of understanding.

The paradigm of chatbots represents an interesting inversion of traditional approaches.

Inversion of Paradigm in Mobile Apps

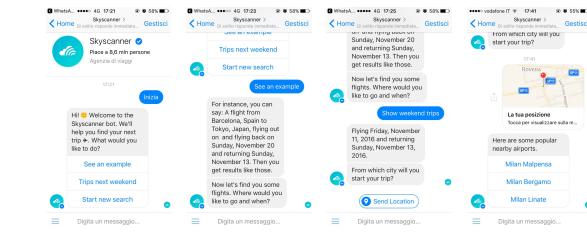
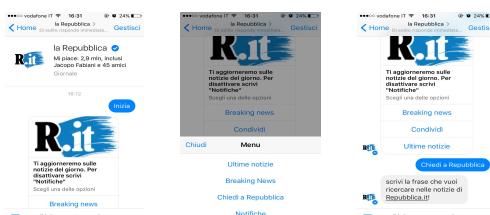
- A BOT is more than a mobile app, it is a new paradigm to integrate mobile apps.
- The current trend is to develop a mobile app equipped with APIs for BOTs.
- Users are reached on the apps that they use most frequently, typically messaging apps such as Messenger or Telegram



The "inversion of paradigm" in mobile apps refers to a shift in how users interact with their devices. Traditional apps require manual interaction: opening the app, navigating through menus, and inputting information. The inverted paradigm, however, utilizes chatbots to streamline the process, allowing users to engage in a more natural, conversational manner to achieve their goals.

For example, you can ask the chatbot to open your diet mobile app and tell you how many calories you have left for the day, or inquire about your fat intake or the number of steps you've taken. You can even ask the chatbot to perform calculations like extracting the square root of a number. The chatbot acts as your intermediary, connecting with the mobile apps through APIs (Application Programming Interfaces) to perform the requested tasks automatically, without the need for you to navigate through app interfaces.

In this way, the chatbot becomes the sole interface, the one-stop-shop for interacting with all your mobile apps. It simplifies the user experience by providing a single point of interaction. However, for this to work, two things are necessary. Firstly, the chatbot needs to be embedded in the operating system with APIs. Secondly, the mobile apps themselves need to utilize these APIs to enable interaction with the chatbot. While some progress has been made in this direction, there is still a long way to go.



To illustrate this concept, let's take a look at the chatbots developed by La Republica and Sky Scanner. These chatbots have shown promising capabilities, although there is still room for improvement.

- Quali sono gli orari di apertura della filiale più vicina a casa mia?
- Vorrei ordinare una spesa in via Politecnico contenente pomodori e zucchine
- Siete aperti il 24 dicembre?
- Potso lavorare con voi inoltrando il mio cv?
- Ho smarrito la password dell'area clienti, posso reimpostarla?
- Potso trovare del pane carasau presso la filiale di Sardegna?
- Quali sono i punti vendita più vicini a me?
- Quali punti servono per poter ordinare la lampada in premio?
- Potrei avere il numero di telefono della filiale di via Bazzini?
- Mi mostri il volantino promozionale?
- Quanti punti ho sulla carta fedeltà?
- Hai delle ricette da consigliarmi per il pane carasau?
- Invio di messaggi di lamentele o di gradimento al bot: es. Che bello che adesso vendete anche il pane carasau!
- Accettate carte di credito?
- Da parte del Bot randomy : "Hei! Sono Pamela, la tua assistente. Ti qualcosa da consigliarti?"
- Da parte del Bot randomy : "Hei! Sono Pamela, la tua assistente, quali prodotti vorresti vedere in offerta?"
- Da parte del Bot randomy : "Hei! Sono Pamela, la tua assistente, buon natale!! Il panettone è in sconto da noi da oggi fino al 6 gennaio!"
- Da parte del Bot randomy : "Hei! Sono Pamela, partecipa anche tu al concorso di Natale!"

PAMela chatbot In terms of interaction, the chatbot primarily relies on button clicks rather than typing or voice input. Through our research with a supermarket called PAM, we identified the most common questions asked by clients that could be answered by a chatbot. We then worked on envisioning different ways these questions could be asked, ensuring that the bot could effectively respond to text-based queries without the need for a specific interface or voice input.

To create an effective chatbot, it is crucial to address a broad range of questions. However, we found that allowing customers the freedom to ask questions in their own natural language poses a significant challenge. We are continuously working on improving this aspect.

Privacy Concerns and Technology

Amazon Alexa

- <https://www.youtube.com/watch?v=b4uG9dfFtE4> from 5 m 45 s
- Companies can add services to Alexa (es. online shopping) and integrate them with Alexa predefined services (e.g. shopping list).
- The design of the semantic capabilities and intelligence of Alexa is not entirely predefined and is largely part of the design of each business application of Alexa (e.g. commands, equivalent formulations of commands, suggestions, interaction paths,...). It's called *situational design*, it includes designing Alexa's conversational skills in your context.

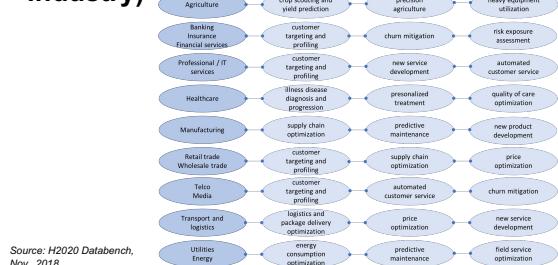


It is worth mentioning popular voice assistants like Alexa, Google Home, and Google Assistant. These platforms allow companies to connect and provide services through voice interactions, simplifying the user experience. However, relying on these third-party technologies means sacrificing some privacy. These tech-

nologies gather extensive information about users, raising concerns about data security and privacy. In Europe, where such technologies are not as prevalent, the General Data Protection Regulation (GDPR) aims to mitigate privacy risks for users.

Applications of Machine Learning and AI in Industry

Machine learning (AI) application priority (by industry)



Source: H2020 Databench, Nov. 2018

This chart presents the most prevalent applications of machine learning and AI, based on a survey conducted with managers in various industries such as agriculture, banking, healthcare, and manufacturing. Take a moment to review this slide and gain insight into the current priorities of managers. Among the recurring services, two stand out: predictive maintenance in manufacturing and targeted services. These applications are widely recognized as the most common and in-demand. While there are other applications available, these two are considered the hottest and most frequently implemented. Many companies have already conducted pilot projects in these areas to assess the potential benefits and understand the associated challenges of applying machine learning.

KPIs and Decision Making

In general, machine learning is used to embed decision-making capabilities into various applications. For instance, in predictive maintenance, machine learning helps determine the optimal timing for executing maintenance interventions. However, it is crucial to define what “optimal” means in this context. It could refer to reducing maintenance costs, minimizing the number of interventions, or improving the quality of service. To ensure effective decision-making, it is essential to associate the appropriate key performance indicators (KPIs) with machine learning.

One significant aspect of machine learning applications is that they automate decision-making processes. Instead of human decision-makers, machines are responsible for making decisions. This automation is what sets machine learning apart from traditional IT applications. When exploring different machine learning applications, it becomes evident that

decision-making is a fundamental component of each one.

The novelty of machine learning lies in the fact that decisions are automated. Unlike humans, who can adapt and improve their decision-making based on the outcomes, machines operate at a fixed level of precision. Once an algorithm is trained, it will continue to make decisions based on the parameters it has been optimized for. Therefore, it is crucial to develop accurate algorithms and ensure they optimize the correct KPIs. Failing to do so can result in financial losses, as machines lack the ability to recognize when decisions are suboptimal or when alternative approaches could be more beneficial.

Due to the risks associated with automating decisions using machine learning, many companies approach this technology with skepticism. They prefer to have human decision-makers involved and compare the decisions made by machines with those made by humans. This approach allows for human oversight and ensures that decisions are thoroughly evaluated before implementation.

Importance of KPIs

SECTOR	PROBLEM	KPI
Finance	Risk exposure assessment	Loss reduction
Accommodation	Targeting	Increased sales/margins
Manufacturing	Predictive maintenance	MTBF, availability/productivity
Health	Compliance checks	Quality of care
Telecom	Network analytics	Quality of customer service
Media	Marketing optimization	Increased revenues/margins
Transport	Churn prediction for targeting promotions	Churn reduction
Utilities	Customer behavior analysis and custom pricing	Increased margins
Oil&Gas	Natural resources exploration	Increased ROI from plant investments
Retail/Wholesale	Optimization of assortment choices, price optimization	Increased sales/margins
Professional Services	Customer profiling	Offer redemption
Government	Contract analytics	Reduced expenses/ service improvement
Education	Student data analysis	Workload balancing

When it comes to the importance of KPIs, it's crucial to set the right ones and consider the decisions you want your machine to make. It may be necessary to train multiple algorithms based on the specific KPI you want to optimize and use the appropriate algorithm at the appropriate time. This is a common approach.

Why should AI be related to business KPIs?

- Because with AI we embed (or support) «decisions» inside software
- Decisions should be driven by business KPIs
- Example:
 - In yield prediction, the precision of yield estimates for different types of crop has a direct impact on the ROI of financial investments.
 - In turn, automating (or supporting) trading decisions should be driven by ROI.

AI should always be aligned with KPIs because it supports decision-making. Decisions should be guided by the right KPIs. It's essential to continuously learn, adapt to the market, and meet the new demands that arise to remain competitive. Therefore, it's vital to

train your machine learning models in a way that enables this ongoing learning process.

Evaluating and Optimizing KPIs

Evaluation of business KPIs

- The benefits of AI/machine learning use cases are rarely quantified.
- There's a lack of business benchmarking initiatives.
- Quantitative evidence almost exclusively comes from suppliers of technology solutions.
- For some use cases, economic benefits are difficult or impossible to quantify (KPIs are simultaneously affected by multiple initiatives).
- A typical managerial question (still) is: do I really need machine learning?

Developing multiple machine learning algorithms and integrating them into an artificial intelligence application is crucial for providing effective decision support. This application should allow users to make decisions manually if desired, and have the flexibility to start and stop different algorithms based on the context. This approach transforms the application into an executive tool rather than just an algorithm. It is a promising direction because it allows for specific algorithms to automate decision-making and optimize it, while in other cases, such as revenue optimization, the focus is on developing applications that support decision-making rather than fully automating it.

To ensure the effectiveness of these algorithms, quantitative evidence is necessary. Evaluating KPIs (Key Performance Indicators) is essential to optimize algorithms and ensure they are achieving the desired outcomes. However, it is not enough to train the algorithm and conclude that it is accurate. KPIs must be continuously measured to assess the algorithm's performance. This ongoing measurement is crucial, and the results should be fed into traditional executive applications for continuous monitoring and control.

Quantitative Evidence and Business KPIs

Evaluation of business KPIs - example

Linear vs. non linear prediction models in the retail industry

	Average % error exponential smoothing	Average % error Holt-Winters	Average % error machine learning (XGBoost)
Total daily revenue	13.18%	36.02%	4.9%
Daily revenue of individual shop	12.9%	19.54%	6.23%
Daily revenue of group of shops with similar seasonality	-	avg 26% opp 10% flat 20.02%	avg 3.44% opp 5.44% flat 5.92%
Daily revenue of individual product	24.11%	26.86%	16.7%
Daily revenue group of similar products	-	14 prod 11.53% 408 prod 16%	14 prod 6.03% 408 prod 5.88%

These examples illustrate different business Key Performance Indicators (KPIs). For instance, in the retail industry, it is important to assess the precision of revenue predictions. The following data is from a real supermarket and demonstrates how the error rate

changes depending on the specificity of the prediction. When making more general revenue predictions for the entire company, the error rate is very low, around 4%. However, as the prediction becomes more specific, such as for a particular shop or a specific category of products like coffee, the error rate tends to increase. For instance, predicting the revenue of a particular brand of coffee in a specific shop may result in an error rate as high as 30%.

Machine Learning Algorithms

Designing and Testing Algorithms

When designing a machine learning application, it is important to consider that different algorithms have different performance levels. Therefore, testing multiple algorithms and selecting the most suitable one for your specific problem and data is crucial. Always compare the models and choose the one that performs the best. It's important to note that there is no universally best machine learning model. The best model depends on the context and the data at hand. To assess the error, you will need to try different models and evaluate their performance.

Context-Dependent Error Assessment

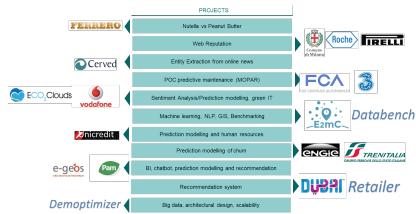
Determining the acceptable level of error is a context-dependent question without a definitive answer. In certain applications, as long as the overall sentiment or outcome is correctly polarized, even if there is a high error rate, the application can still be successful. For example, in sentiment analysis, if the goal is to understand the general sentiment of customers towards products and brands, a high error rate may be acceptable as long as the sentiment is correctly polarized as positive. It is not necessary to achieve absolute precision, as that would make the application unreliable. However, it is important to avoid a level of error that is equivalent to flipping a coin. An accuracy rate of 30% or 70% may be sufficient in some cases.

Benefits and Applications

In revenue prediction, companies aim for a low error rate, typically below 5%. Some companies even require an error rate below 3%. However, achieving such precision may not be possible in all applications. For example, when using revenue prediction in the supply chain to determine how much to order from a supplier, precision becomes a challenge.

Our research group has extensive experience in applying machine learning in various areas, as shown in

We have observed the benefits of machine learning in a variety of contexts:



the chart. We have developed applications for different companies. Despite the proven benefits of machine learning in these contexts, managers often remain skeptical.

Managerial Skepticism and Training

Why are managers (still) skeptical?

- Because AI and machine learning are (and are perceived as) complex.
- Because there is no off-the-shelf technical solution.
- Because technology is special-purpose and expensive.
- Because AI and machine learning are seen as a threat by decision makers (in fact, it may replace some of them).
- Because AI and machine learning are associated with the concept of «big data» which adds to their complexity.

Perception of Complexity

The skepticism towards AI and machine learning among managers often stems from the perception of complexity. When managers hear terms like “linear regression,” they may have a basic understanding of the concept and feel comfortable within their knowledge zone. However, when it comes to AI, terms like “supervised,” “unsupervised,” “ground truth,” “neural networks,” and “deep learning” can create confusion and a sense of being lost. Managers see AI as a black box, something they have no control over and don’t fully understand. They worry that relying on AI for decision-making will result in a loss of control and decision-making capabilities.

Reducing Skepticism with Training

In order to address this issue, it is crucial to provide training to the managers. By offering training sessions that cover the basics of AI and machine learning, as well as providing an objective understanding of what can be expected and the significance of business APIs, skepticism can be reduced. It is important to emphasize the development of a comprehensive AI application that allows managers to actively engage with the system and not solely rely on the algorithm. Without proper training, managers may continue to harbor skepticism.

Application-Specific Acceptance

This means that certain applications do not pose a problem. For example, in the case of predictive maintenance, if an engineer assures them that an AI algorithm can predict better than they can, they are likely to trust and implement it. However, in other contexts such as revenue management, where setting the price of a product or service is crucial to the company’s effectiveness and competitiveness, even a small amount of skepticism can lead them to choose a non-fully automated solution.

Challenges in AI and ML Adoption

Lack of Off-the-Shelf Solutions

When it comes to innovation and technology, there are always enthusiastic managers who fully embrace automation and technology, regardless of the challenges. However, one of the main obstacles to the widespread adoption of machine learning and artificial intelligence is the lack of off-the-shelf solutions. This means that companies need to invest time and effort into working with data and designing customized solutions that fit their specific needs.

Managerial Decision Automation

Implementing technology, especially specialized and expensive technology, can pose challenges for managers. One of these challenges is the decision to automate their own decision-making processes. This decision can create a conflict of interest for managers. By opting for machine learning and automation, managers may fear that they will lose their job or diminish their importance within the company. This fear stems from the potential reduction in their workload and the number of people they collaborate with. As a result, managers may be hesitant to embrace automation due to concerns about the impact on their role and status within the organization.

Association with Big Data

Lastly, it is important to note that AI and machine learning are closely linked to the concept of big data, which further complicates their implementation. This is the second part of our discussion, and additional recordings will be available soon. We will begin by explaining the significance of big data and why it is relevant at this time.

Big Data Analytics - II Lecture

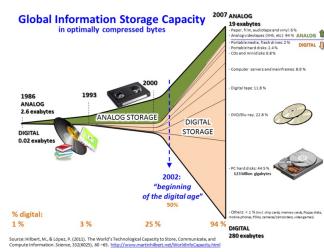
Introduction to Big Data

Good morning, class. Today, we will be discussing the concept of big data and its magnitude. To begin, let me share my screen so we can dive into the presentation slides. Now, the question that naturally arises is: how big is big data?

The Rise of Big Data

Global Data Growth

Big data is a broad term for data sets so large or complex that traditional data processing applications are inadequate (*Source: Wikipedia*).



The rise of big data is a result of two main factors: the exponential increase in the amount of data produced globally and the shift from analog to digital support. If we consider big data as the vast amount of information produced globally on any type of support, we can see from a chart sourced from Wikipedia that there has been a significant increase in data production since around 2002. This coincides with the beginning of the digital age, marked by the widespread adoption of the internet and the subsequent emergence of social media platforms. The global connectivity facilitated by these technological advancements has led to a surge in the sheer volume of information generated. Additionally, there has been a transition from analog support, such as tapes, to digital support, further contributing to the growth of big data.

Digital Age and Data Explosion

Erik Schmidt (Executive Chairman Google): «From the dawn of civilization until 2003, humankind generated 5 Exabytes of data. Now, we are producing 5 exabytes every two days, and the pace is accelerating.»

Name	Symbol	Power
Kilobyte	KB	10^3
Megabyte	MB	10^6
Gigabyte	GB	10^9
Terabyte	TB	10^{12}
Petabyte	PB	10^{15}
Exabyte	EB	10^{18}
Zettabyte	ZB	10^{21}

In terms of quantity, the executive chairman of Google has provided a striking summary of these trends. He noted that from the beginning of human civilization until 2003, we generated a total of five ex-

abytes of data. However, currently, we are producing the same amount of data, five exabytes, every two days, and this rate is increasing rapidly. This global perspective aligns with the information presented in the chart we just reviewed on Wikipedia.

Understanding Data Units

Data Measurement Units

But from a business perspective, do we really need to talk about exabytes when discussing big data? Let's start with a brief summary of what exabytes are. The units of data measurement range from kilobyte to zettabyte, with kilobyte, megabyte, gigabyte, terabyte, petabyte, and exabyte in between. You're probably familiar with gigabytes and megabytes because you can typically store up to one terabyte of data on your laptop's hard drive. So you have a general understanding of what a terabyte is and how much information it can hold. To put it in perspective, one thousand terabytes make up a petabyte, one thousand petabytes make up an exabyte, and one thousand exabytes make up a zettabyte.

Forecast of IP Traffic

...and global IP traffic is forecasted to reach 3 ZB/year, roughly 4 EB/day by 2021

Year	Global Internet Traffic
2001	1 EB/year
2004	1 EB/month
2007	1 EB/week
2013	1 EB/day
2021	4 EB/day

To better understand the trends we are discussing, it is forecasted that IP traffic will reach three zettabytes per year by the end of 2021. It's important to note that this is still a forecast and the actual data is not yet available. Zettabytes, along with exabytes, are significant units of measurement in this context.

Defining Big Data

- Big data is «a collection of data from traditional and digital sources inside and outside your company that represents a source for ongoing discovery and analysis.» (*Source: Forbes*)
- Big data is any amount of data that raises technical scalability challenges for a given company due to the increasing growth rate of data and a need for continuous analysis.

Business Perspective

Before we can discuss the technical aspects and requirements of big data, it is important to define what exactly big data is from a business perspective. While some may argue that terabytes of data are not sufficient to

be considered big data, it is crucial to understand that the size of the data alone does not determine its classification. To provide a practical answer to this question, let's refer to Forbes' definition of big data, which states that it is *a collection of data from both traditional and digital sources, both within and outside an organization*. This data serves as a valuable resource for ongoing discovery and analysis.

What stands out in this definition is the close relationship between big data and analysis. The true essence of big data lies in its ability to be analyzed and interpreted for meaningful insights.

Technical Scalability Challenges

Big data and analytics are closely intertwined and often referred to together as “big data analytics.” Big data refers to a large volume of data that can provide valuable insights when analyzed. From a technical perspective, big data is any amount of data that presents scalability challenges during analysis. Even relatively small datasets can pose technical scalability issues depending on the type of analytics being performed. In fact, even a few gigabytes of data can be considered big data for certain types of analytics. Terabytes of data are certainly considered big data, even if they can be stored on a laptop’s hard drive.

Analyzing terabytes of data can be a challenging task. Just think about how long it takes to back up the data on your hard drive, which can require hours for just a few hundred gigabytes. This highlights the technical challenges that arise when building interactive applications that require fast response times but involve transferring relatively small amounts of data.

While industrial systems are more powerful than laptops, it’s important to recognize that as data size grows, time becomes a significant factor in both personal and business contexts. This is especially true for enterprise technologies.

Classification of Data Types

Conversation text data	• e.g. Twitter, Facebook
Photo and video image data	• e.g. YouTube
Audio files	• e.g. call centers
Sensor data	• e.g. geo seismic data
The Internet of Things data	• e.g. smart devices, smart phones
Web customer data	• e.g. Web logs
Traditional customer data	• e.g. receipts, loyalty programs, traffic data of telephone/internet operators

Now, let's take a closer look at the different types of data and their sizes within the realm of big data. We can classify the data into various categories, such as conversation text data from platforms like Twitter and

Facebook, photo and video image data from platforms like YouTube, audio files from call centers, sensor data like seismic or satellite data, Internet of Things (IoT) data collected from smart devices and smartphones, web customer data including web logs that track customer actions on websites, and traditional customer data like receipts, loyalty programs, and traffic data from telephone and internet operators.

Conversation Text Data

To give you an idea of the scale of these data types, let's start with conversation text data from Twitter and Facebook. On average, around 6,000 tweets are posted every second on Twitter. If we focus solely on text-based tweets and exclude images and videos, this amounts to approximately 200 billion tweets per year, equivalent to 25 terabytes of data annually.

Photo and Video Image Data

Analyzing data may seem like a small task, but it becomes significant when dealing with large amounts of information. For instance, if you use a semantic engine to process text data, it can take approximately one day to process one megabyte on a single core of a server. This means that analyzing 25 terabytes of data would require a substantial amount of time. It's important to note that the amount of data goes beyond just Twitter; there are also 152 million blogs, Facebook, and even text data from YouTube. Additionally, image, audio, and video data are even larger in size. While text data is measured in terabytes, a JPEG picture can range from one to six megabytes, depending on its quality. On Facebook alone, this adds up to approximately 120 petabytes of pictures per year.

Audio Files

When it comes to audio recordings, the amount of data can quickly reach petabytes. In the context of a call center, where an average conversation is about 20 megabytes, and the center handles around 1000 calls per day, recording all calls would result in approximately 1.3 gigabytes of data per day. This adds up to half a terabyte of audio recordings per year. Therefore, the volume of audio data is still in the terabytes range.

Sensor Data

When it comes to video data, the size can quickly add up. High-quality video typically takes up around 100 megabytes per minute, and on platforms like YouTube, this amounts to a staggering 2.5 petabytes per day.

This demonstrates the immense volume of data involved.

However, sensor data presents an even more challenging scenario. Sensors have the capability to record audio, capture images, and even record videos. They can also combine different types of data, such as photos with related text or videos with audio streams. Sensor data is collected continuously and can easily accumulate to the petabyte scale. For instance, a video surveillance service alone can generate one petabyte of data in just five days.

Internet of Things Data

Typically, video surveillance services do not store their data for extended periods of time. They record videos but eventually delete them. On the other hand, the Internet of Things (IoT) is rapidly expanding, with 26 billion units installed in 2020 and counting. The IoT generates a significant amount of data, producing approximately 10 petabytes per year if each unit generates one kilobyte of text daily. This amount is equivalent to 40 times the text data produced by Twitter and Facebook combined. It's important to note that the IoT data also includes photos, audio, and video, which further contributes to the overall data volume, easily reaching the petabyte scale.

Web Customer Data

In practice, companies often transfer streaming data to a central location where it is processed and only a summary of the IoT data is permanently stored. This approach is both economically and technically feasible. For example, web customer data in a log file is not large, typically ranging from 250 to 750 bytes. However, when accumulated over time, it can add up to 7.5 megabytes per day for a single site. At an enterprise level, this can reach several gigabytes per day, resulting in a few terabytes per year.

To manage this data size, organizations do not store all the data indefinitely. Instead, they retain it for a certain period of time and then apply log file rotation on a daily, weekly, or monthly basis. This means that even a few terabytes per year prompts companies to implement data lifecycle management, periodically deleting data to avoid exceeding a certain threshold of permanently stored data.

Traditional Customer Data

Traditional customer data refers to the data collected from customers in a business context. The size of this data can vary depending on the type and size of the business, ranging from 0.5 to 10 terabytes per year

when compressed. The largest component of traditional customer data is transaction information, which is crucial in an enterprise context.

While this amount of data may not seem significant, it becomes more substantial when considering industries like banking. Banks are required to retain transaction data for an extended period, typically up to 10 years. As a result, banks accumulate a large volume of data over time. For example, an Italian bank would have slightly less than a petabyte of data in total.

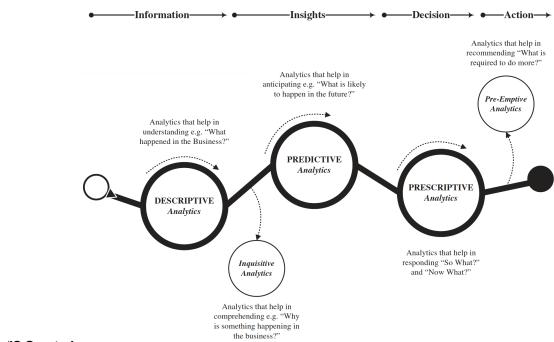
Big Data in Practice

Although traditional relational technologies can handle large data sizes, they are not efficient when it comes to data analytics and analysis. This is mainly due to factors such as data normalization, which ensures correctness and consistency but hampers fast data access. So, while traditional technologies are suitable for managing data, they are slow when it comes to analyzing it.

In the next class, we will explore how SQL technologies have evolved to address the challenges of big data. We will learn about more efficient tools and techniques that can be used to handle big data projects.

Big Data Analytics - III Lecture

Evolution of Big Data Projects



Now, let's discuss the framework for understanding the evolution of big data projects. Typically, there are three main types of analytics: descriptive, predictive, and prescriptive. These analytics require different technologies and represent different stages of development in handling big data. However, it's important to note that each stage builds upon the previous ones, so descriptive analytics are not eliminated in the subsequent steps.

As companies progress in their understanding and utilization of big data, they go through an evolution from descriptive to prescriptive analytics. This means that they start with descriptive analytics and gradually move towards more advanced forms of analysis. By the time a company completes this evolution, they typically have all types of analytics integrated into their operations.

Descriptive Analytics

Traditional Business Intelligence

Descriptive analytics, also known as traditional business intelligence, involves taking data and calculating summary indicators based on that data. This process is similar to what is done in executive information systems, which we discussed in the BIS1 lecture. In essence, calculating these indicators is equivalent to running code to provide descriptive analytics. Therefore, descriptive analytics and traditional business intelligence can be used interchangeably to refer to this type of analysis.

Data Warehousing and Performance

In our previous discussions, we explored how traditional business intelligence is enhanced through the creation of a data warehouse. This allows for the summarization of big data stored in operational databases, enabling the calculation of descriptive analytics. While

these analytics may not always be instantly available, they can be efficiently calculated with good performance. In some cases, batch procedures are used to generate reports, which are then shared either through a mailing list or a shared document space.

Predictive Analytics

Decision Making and Predictions

Companies often progress to the use of predictive analytics to enhance their decision-making processes. By leveraging their data, they can make more informed predictions, which serve as the foundation for effective decision-making. To illustrate the importance of predictions, let's consider a manufacturing company. Managers in such companies must determine how many products to produce. However, this decision relies on an evaluation of future market demand, as the production process often takes several months. Therefore, accurate predictions of future sales are crucial. This example demonstrates the connection between decision-making and the need for predictions.

Advanced Techniques and Machine Learning

When companies have accumulated sufficient data and have a reliable information system in place, they can leverage this data to make predictions about demand. The demand curve typically fluctuates, and if the market is growing, there may be an upward trend. To forecast future demand, companies can analyze the demand curve and trend line to make predictions. The most common approach is linear modeling, which involves estimating the trend line and using a linear model to predict growth and demand.

However, in recent times, companies have started to adopt more advanced algorithms that go beyond simple trend lines. One example is the use of machine learning, specifically the random forest algorithm, to predict sales. Machine learning techniques have been shown to yield better results by reducing errors. In previous classes, we have explored an example of using a random forest to predict sales and observed the improved accuracy that advanced techniques can provide.

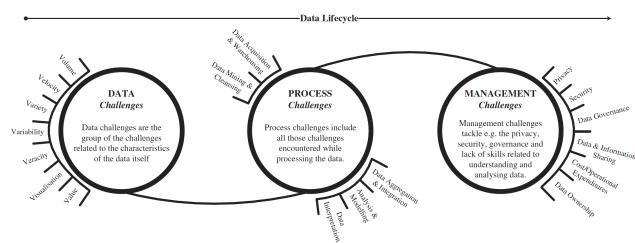
Prescriptive Analytics

Once a company has embraced and mastered the use of advanced predictive analytics, they can begin to trust the analytical predictions based on data over their own intuition and market knowledge. This is when they can fully rely on algorithms and receive prescriptions for decision-making. Moving towards prescriptive analytics involves automating decisions to some extent.

It is important to note that companies are often hesitant to automate decisions for various reasons, as we have previously discussed. However, a prescriptive approach can be applied to less critical decisions, allowing human decision-making to focus on the most critical ones. These critical decisions are the ones that change frequently and require continuous creativity and attention to ensure they are made in the best possible way.

Big Data Challenges

Classification of Challenges



When it comes to decision-making, there are often choices that go beyond what individuals can handle due to limited rationality. In these cases, it becomes necessary to delegate these decisions to machines. However, this process is not without its challenges. These challenges can be classified into three main categories: data challenges, process challenges, and management challenges.

Data Challenges Data challenges involve obtaining the necessary data, interpreting it correctly, and preparing it for the analytics process. This can be a complex task, as data comes in various formats and from different sources.

Process Challenges Process challenges are related to implementing changes within an organization to effectively utilize analytics. This involves adapting existing processes and workflows to incorporate data-driven insights and recommendations.

Management Challenges Lastly, management challenges encompass overseeing the entire process and ensuring its effectiveness. This includes managing resources, coordinating teams, and making strategic decisions to maximize the benefits of analytics.

While all three categories of challenges are important, management challenges tend to be the most prevalent. This is because effectively managing the entire process is crucial for achieving successful outcomes.

By understanding and addressing these challenges, organizations can navigate the complexities of utilizing big data and make informed decisions that drive

positive change.

Issues with Big Data Projects

1. Getting the technical skills needed to manage the new technologies for big data
2. Getting the data, which are very often stored in multiple databases, not integrated, not ready for analysis (e.g. not structured, not real time)
3. Getting the analytical skills to explore data and gather new and useful insights
4. Achieving business involvement

Technical Skills and Technology Platforms One of the main issues in dealing with big data is acquiring the necessary technical skills to effectively manage the new technologies involved. While there is a lot of discussion surrounding big data, companies will struggle to be effective if they lack the technical expertise required to handle it. In order to perform analytics, the first step is to have the appropriate technology in place. While it is possible to run pilot programs or perform some analytics without fully implementing the technology platform, at some point, it becomes necessary to adopt the platform. Obtaining the required skills is crucial in this process.

Cloud computing can be a valuable solution as it provides a ready-to-use platform for analytics. However, the costs associated with cloud computing can be a deterrent for many companies. This expense often leads to reluctance in utilizing cloud computing services.

Data Integration and Preparation Data integration and preparation pose significant challenges in the realm of big data. Often, data is stored in multiple databases that lack integration and adhere to different standards. This lack of integration makes the data unfit for analysis. For instance, call center recordings need to be structured using speech-to-text technology and labeled before they can be analyzed. Without this preparation, running analytics on the data becomes impossible.

Furthermore, obtaining useful insights from the data requires a combination of analytical skills in computer science, business, and statistics. This presents a management challenge as it is rare to find all these skills in a single individual. Building a team with diverse expertise becomes crucial. However, managing such a team can be complex. It involves finding the right people, fostering a cooperative environment, and ensuring effective collaboration among team members. This management challenge is essential for successful data analysis and utilization.

Management and Organizational Challenges Lastly, achieving business involvement is crucial in the

process of transforming an organization through analytics. However, this is not an easy task. It requires strong motivation from top management, as without their support, the transformation is unlikely to happen from the bottom up. Additionally, there will be internal resistance to change, as is common in any innovation project. This resistance will be even more challenging to overcome because it involves changing the way managers work. Unlike automating clerical work, implementing big data and analytics addresses decision-making processes. Therefore, managers must recognize the need for support to improve their work, which can be a difficult mindset to shift.

Technology Limitations and Scalability

When it comes to big data, companies face various technical challenges that require investment in technology. In the past, companies could work with small data and perform simple analytics using tools like Excel. Excel was popular because it was user-friendly and flexible, allowing users to easily calculate indicators and make changes to their analytics. Managers could independently work with Excel without relying on the IT department for every request.

However, Excel has its limitations. For instance, it cannot handle datasets with more than 1 million rows. Opening a CSV file with more than 1 million rows is not possible in Excel. This limitation poses a problem when dealing with big data.

SQL and NoSQL Databases

One limitation of SQL databases is the number of columns they can handle. However, this limitation is usually not a major issue when loading files from an SQL database, as the number of attributes is typically much lower than the maximum limit of 16,000. The more common limitation is the number of rows, which is often capped at 1 million. This means that using Excel to handle such large datasets is not feasible, as Excel starts to slow down significantly even with just 100,000 rows. The practical maximum for Excel is usually much lower than 1 million rows.

To overcome this limitation, one option is to use a database like MySQL. However, MySQL caches data in memory and stores it on disk, which means it can exceed the available RAM on your PC. For example, if you have a one terabyte hard drive, you can theoretically use the entire space for data storage. While this may seem like a solution, there is a rule of thumb to ensure Excel's efficiency: you need to have at least 10% of the disk size in memory to achieve optimal performance.

Oracle Scalability

- The maximum size of the Oracle database is 8 EB.
- This size can accommodate any type of data and is well beyond the typical multi-media big data requirements.
- Oracle is integrated with Hadoop (non relational approach, see next slides) and, therefore, can integrate large files without migrating them into relational tables.
- Oracle is integrated with R, enabling easy access to (open source) analytics and responding to end-to-end knowledge discovery requirements.
- However, schema is fixed, indexing is optimized for transactional systems, complex data manipulations are often difficult/impossible with sql and usually executed outside of Oracle, fast access to result tables in systems such as Neteza and Teradata shows flexibility and performance limitations.

If you have one terabyte of data on your disk, MySQL will require 100 gigabytes of RAM to perform well. This means that the limitation is not the disk, but the memory. When there is not enough memory, MySQL stores data on disk, which significantly slows down queries. In some cases, queries may not even converge, causing delays and incomplete results. To overcome these limitations, you can build a cluster of machines or consider using cloud computing. However, storing one terabyte in the cloud and running efficient MySQL queries would require at least 10 servers, resulting in significant costs.

When it comes to scalability, Oracle claims a maximum database size of eight exabytes, which is a substantial amount. However, in the context of big data, we haven't reached the exabyte scale in any of the examples discussed. Oracle offers additional advantages, such as native integration with NoSQL databases like Hadoop and various analytics tools, including the open-source R tool. Despite these advantages, it's important to note that Oracle is an SQL database.

The limitations of SQL databases lie in their approach to handling large amounts of data. While they offer data dependability and transaction correctness, their performance can be a disadvantage. To ensure correctness, data needs to be split into multiple tables, and queries involving join operations can create scalability issues. Alternative technologies like IBM Netezza and Teradata offer better performance but come at a high cost. Another option is the NoSQL paradigm, which allows for denormalized data storage, reducing the need for join operations. However, NoSQL databases like Hadoop are optimized for sequential read and have poor random read performance, making them less suitable for machine learning algorithms.

Hadoop Scalability

Hadoop has two main components:

- **Hadoop Distributed File System (HDFS):** a distributed, scalable and portable filesystem
- **MapReduce:** a distributed, fault-tolerant resource manager and scheduler for processing large data sets

Hadoop, an open-source Apache technology, is not just a database but an ecosystem of tools. It con-

sists of Hadoop Distributed File System (HDFS) and MapReduce, which provide a way to query large tables without the issues faced by SQL databases. Hadoop also includes components like Hive for running SQL queries, connectors to various analytics environments, and libraries for machine learning. Commercial distributions like Cloudera, MapR, and Pivotal offer additional features and simplify enterprise-level management of Hadoop.

Strengths	Weaknesses
<ul style="list-style-type: none"> Write-once-read-many model enables high-throughput access to data (works well for analytics, less so for transaction processing) Individual files are broken into blocks of a large size (default 64MB) and stored across the cluster. A typical block size of a common file system such as NTFS (Windows file system) is in the order of KBs. Impressive sequential read performance 	<ul style="list-style-type: none"> Bad random read performance. Poor performance with small files.

However, companies are now questioning the performance and suitability of Hadoop for all tasks. Its optimization for sequential read and poor write performance make it challenging to use as a single database solution. Another challenge is data integration, as companies often have data scattered across different tools and systems. Data lifecycle management is also crucial, as data becomes obsolete and needs to be deleted. This process is more complex in analytical systems, requiring careful coding to keep data updated and ensure timely deletion.

Data Science Tools and Automation

One of the challenges organizations face is acquiring the right skills for data science. It can be difficult to find skilled data scientists who can effectively work with computer scientists to extract insights from data. To address this challenge, there are tools available, such as KNIME, that enable end-to-end machine learning and automate the data science cycle. These tools aim to streamline the process by eliminating the need for coding. Unlike programming languages like R or Python, which require coding to obtain results, these tools offer a no coding approach. However, it's important to note that there is still a significant amount of data preparation required before being able to upload a clean CSV file into these tools.

Leadership and Company Culture

If data preparation is not done correctly, the tools used will not be effective in providing support or help in correcting data errors. These tools also have other limitations, such as automatically assigning types to columns based on the first 10,000 values. However, this can lead to errors if the type assigned is not accurate for all the data. For example, a column may be assigned a numeric type, but the 10,001st value could be a string,

causing errors in analysis.

- The main organizational issue with big data is **human resource**. Talent management is critical to have good **data scientists** who can extract value from data. Along with the data scientists, a new generation of **computer scientists** are designing techniques for processing very large data sets.
- Leadership** is another issue, since companies need clear vision and goals to enable coherent and target-oriented data analyses.
- Company culture** should become data driven. This requires to move away from acting on instinct and HiPPO decisions (decisions based on the highest-paid person's opinion).

To overcome these challenges, it is important to have a data scientist who is not only skilled in statistics but also has computer engineering skills. Collaboration between data scientists and computer scientists is necessary for end-to-end automation and efficient data preparation and maintenance. This highlights the need for a team rather than relying solely on individual expertise.

Leadership plays a crucial role in addressing these challenges. Clear goals must be set for the team to ensure effective data preparation and analysis. Additionally, company culture is an important factor to consider. A culture that values data-driven decision-making and encourages collaboration between different teams can greatly contribute to overcoming these challenges.

Companies often rely on the “HiPPO decision”, where the highest paid person’s opinion is considered the final say. It’s comfortable to have someone else make decisions for you. However, stepping out of this comfort zone and being equipped with tools to make informed decisions can be challenging. Even the highest paid person in the company may struggle to admit that tools can be helpful. To achieve effective decision-making, it is crucial to involve the entire business and foster a data-oriented company culture. This requires significant change management efforts. Evangelization and taking on big data projects step by step are essential in this process.

Big Data Analytics - IV Lecture

Introduction to Big Data Solutions and Case Studies

In this class, we will be exploring various solutions and case studies of big data projects. Before we dive into the content, I would like to address a topic that was briefly mentioned in the previous class: achieving business involvement.

Organizational issues: achieving business involvement

- Even with the right skills and a strong leadership, building a data-oriented company culture can be a challenge.
- On one hand, culture can be changed when data are available. On the other hand, making the data available requires a considerable degree of business involvement and commitment.
- Evangelization and use cases are key to obtain the initial commitment to embark in a big data project.

Example

Utility companies have millions of smart meters installed providing quasi real-time data on customers. However, a few of them use this information to gather insights and improve their service. What are possible key analytics on data from smart meters that could demonstrate the potential of big data analytics? Simulation of more customized customer offers could constitute an interesting PoC.

When it comes to implementing big data projects, companies often face a dilemma. They may not know where to start because they need the right data to run a successful pilot, which can then be used to convince other managers and key stakeholders to support the transformation. However, obtaining this data requires strong business involvement.

In such cases, the best approach is to prioritize management involvement, starting from the top. By taking small, tangible steps that can provide immediate benefits, companies can begin the process of change and build confidence. While management involvement is top-down, the actual implementation and rollout of the project may be more bottom-up.

Big Data Platforms and Vendors

Overview of Big Data Vendors

Let's begin by exploring the different platforms available for big data solutions and examining some case studies. While it's common to think of IBM, Microsoft, Oracle, SAP, and the major global cloud platforms as the primary vendors in this space, there are actually a total of 43 vendors offering solutions in the big data and analytics field, according to Gartner. It's crucial to recognize that there is a wide range of options available to companies, and they are not limited to just the mega vendors.

Mega Vendors vs. Other Vendors

It is important to note that while mega vendors have a strong market position, they are often less innovative

The Gartner Magic Quadrant shows **43 vendors**:

- Four vendors are called "Megavendors": IBM, Microsoft, Oracle and SAP.
- Only two smaller vendors operate with a cloud-based approach.
- Only seven tools provide streaming BI functionalities.
- There exists a variety of smaller vendors.
- Megavendors show the lowest market growth rate, while data discovery leaders show the highest market growth rate.

when it comes to the applications of big data and analytics. Their strategy typically involves waiting for a player in a new market segment to emerge as a winner and then acquiring them. This strategy works well for mega vendors due to their financial power. However, out of the 43 vendors listed by Gartner, only seven offer streaming business intelligence (BI) functionalities. Despite the hype around real-time BI and streaming data, only a small minority of vendors provide truly innovative solutions in this area. According to Gartner, descriptive analytics, which refers to traditional reporting, continues to be the most widely used BI capability.

Streaming BI and Real-Time Analytics

- Reporting continues to be the most widely used BI capability, but vendors that give a broader range of users access to more difficult types of analysis have the highest customer satisfaction and deliver the strongest business benefits.
- Data discovery vendors lead versus other vendor types in three key measures: aggregate product score, ease of use, and the complexity of analysis conducted by users. They also deliver the highest business benefits. This likely explains their market momentum.

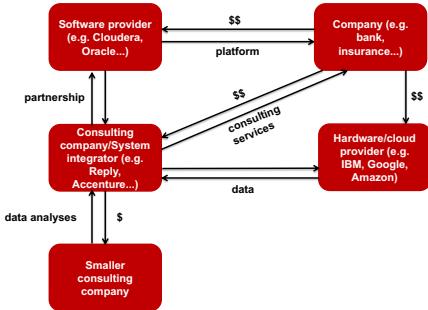
While the megavendors are good at managing large data sizes, their ability to extract knowledge from data seems a weakness compared to other players.

Within the realm of big data platforms and vendors, there is a specific group known as data discovery vendors. These vendors excel in providing innovative and advanced capabilities for leveraging big data analytics to drive innovation within companies. While mega vendors are typically better at managing large volumes of data, their ability to extract knowledge from that data is often weaker compared to other vendors. Knowledge extraction is a complex process that takes time, and there is a lengthy value chain within the market.

For example, when a user end company, like a bank or insurance company, seeks a solution, they typically purchase software from providers such as Cloudera or Oracle.

Knowledge Extraction and Value Chain

When it comes to building a data lake and performing analytics, companies often follow a multi-step process. Let's take Oracle as an example. First, they purchase a database license from Oracle. Then, they hire a consulting company or a system integrator to build the data lake using Oracle as the storage platform for analytics. To install Oracle, they turn to hardware or



cloud providers like IBM, Google, or Amazon to purchase the necessary processing capacity. Alternatively, they can use Oracle's own cloud to install Cloudera and run the analytics.

Now, the question arises: who actually performs the knowledge extraction and analytics? This task can be carried out by the system integrator themselves or in collaboration with smaller consulting companies.

Role of Consulting Companies

Now let's explore the important role that smaller consulting companies play in the market. In the consulting services industry, there are not only the 40 global competitors identified by Gartner, but also numerous local smaller players that are highly profitable. One example of this is SAS, a tool for analytics. The SAS ecosystem consists of smaller consulting companies that specialize in using SAS and provide consulting services to end-user companies, such as banks and insurance companies, who have purchased a SAS license. These smaller consulting companies help the end-user companies utilize SAS and perform valuable analytics.

- they gather data from external sources: for example, they develop crawlers or crawl/classify/score manually to fill in a DB for Web reputation analyses
- they perform small and relatively simple system integration projects
- they develop complex analytics ad hoc (for example, they develop customers segmentation or sales prediction models tailored to their customers' sales data)
- they provide industry dependent knowledge (for example, they are specialized in mass retailing and provide marketing insights based on their customers' sales data)
- they are partners of larger technology providers and perform software customization, analytics, and reporting on behalf of the larger provider

Smaller consulting companies have various roles, as exemplified by the SAS ecosystem. They can gather data from external sources, such as purchasing web price benchmarks from a third party that crawls competitors' websites for price data. They can also handle small and relatively simple system integration projects, particularly for innovative applications, where they cover the entire value chain from running analytics to deploying models and implementing software. Additionally, they have the capability to develop complex analytics and models, such as customer segmentation and sales prediction models, which require industry-specific expertise. These smaller consulting companies provide valuable industry-dependent knowledge, such as offering marketing insights based on customer sales

data in the mass retailing sector.

Furthermore, smaller consulting companies can form partnerships with larger technology providers, like being a Microsoft Gold Partner. This partnership allows them to promote the use of the technology provider's products while benefiting from the association with an established global brand. By staying close to these larger brands, smaller consulting companies can provide services in the local market that add considerable value to local companies.

It is worth noting that the dependence of smaller consulting companies on a specific technology provider may raise concerns about their objectivity in consulting activities. However, their close ties to a particular provider do not diminish the value they bring to the table.

Open Source Software in Big Data

- Open source technologies are growing out of their children shoes, granting big data capabilities to **smaller consulting companies** (without the intermediation of large technology vendors).
- **Success stories** from companies applying innovative approaches to BI are increasing in number and are no longer limited to smaller organizations.
- Companies are under pressure and have an increasing need for extracting value from data to improve their competitiveness in the **short term**, as opposed to starting long and risky projects involving major organizational changes.

The open source market is experiencing significant growth, offering a wide range of technologies that can be utilized by smaller consulting companies to meet the needs of large enterprises and corporations. There are numerous success stories of smaller companies leveraging open source software to extract value from data without the risk of technology lock-in. By embracing independent open source technologies, these companies can achieve remarkable success.

Approaches to Big Data and Analytics

Two types of innovation:

1. «**Quick fix**» innovation: companies look for insights that can provide business value quickly without any major organizational change or integration with operations
2. «**Data-driven business process reengineering**»: companies embark in long-term organizational change to transform into a data-driven organizations basing decisions on evidence

Quick Fix Approach

When it comes to big data and analytics in business innovation, a good starting point is to utilize the existing data. The company should focus on using the most readily available data to create pilot projects that demonstrate the benefits of a data-driven decision-making approach. It's important to emphasize the use of advanced analytics rather than just reporting. This approach is commonly referred to as the "quick fix" approach.

The goal of the quick fix approach is to identify insights that can provide measurable business value. By conducting pilot projects and showcasing the tangible benefits, you can present the results to managers and demonstrate the potential of data-driven decision-making. This will help to build support and encourage further innovation in this direction.

Once the company is ready to expand beyond pilot projects and move towards full-scale implementation, it signifies a readiness to embark on data-driven business process re-engineering. This is a long-term organizational change that involves improving internal competencies, such as scientists and computer engineers, deploying the appropriate technology, and implementing projects that continuously measure key performance indicators (KPIs).

No.	Industry	Project
1	Oil & gas	Saipem, Implementing a prediction model to improve effort estimates in complex engineering projects, without changing the organizational practices of engineers, but by integrating data from different CAD applications.
2	Retail	P&G, Improving general pricing strategy by applying discounts according to customer perceptions and related success of past offerings.
3	Banking (HR)	UBS, Predicting candidate behaviour and improving employee performance (getting the data is a challenge, often unstructured).
No.	Type	Project
4	Manufacturing	Whirlpool gathers new data by embedding sensors in products to track actual product usage and mine social media for customer sentiment for product innovation.
5	Financial services	SEC (US Securities and Exchange Commission) needed insights to highlight hedge funds that required further investigation and used data analytics to identify outliers based on data inconsistencies (under a program called Aberration Performance Inquiry).
6	Media	NBC Universal makes changes to television programming in response to real-time customer sentiment, e.g. quasi real-time decisions on time slots (hours)
7	Grocery	7-Eleven Japan is Japan's most profitable retailer and heavily invested in data analytics by providing store clerks with a dashboard to make decisions on fresh food (stores open and receive deliveries three times a day). Each year 70% of the products sold are new products to the chain as a whole

An example of the quick fix approach in action can be seen in the retail industry, specifically in a supermarket's second row. By applying discounts based on the success of past offerings, the supermarket can leverage data to optimize their pricing strategy and drive customer engagement.

Success can be measured in different ways. One approach is a highly data-driven model, where decisions on product discounts are based on the success of previous promotions. Another approach involves salespeople (or in this case, procurement people) contacting suppliers and proposing cooperation in promotions. The products to promote are selected based on the willingness of the supplier to share the discounts. Both approaches can be successful, but they can also be complemented by alternative approaches, such as selecting products that have been successfully promoted.

Data-Driven Business Process Re-Engineering

Amazon is a prime example of a data-driven company. They use predictive analytics for cross-selling, advertising, and recommendations. However, their recommendation system may not always be sophisticated. Often, they recommend products that you have already purchased, assuming you will buy more of the same.

examples – Amazon

- Epitomy of data-driven company, always.
- Predictive analytics are applied to cross-selling and advertising.
- Today's recommendations are based on each customer's wish list, items they have reviewed and what similar people have purchased – this creates a rounded profile of a customer used for predictive analytics.
- Are the only company that have a patent that allows them to ship goods before an order has even been placed.

Sometimes, they fail to differentiate between different categories of products, leading to recommendations for items you are unlikely to buy again. For instance, if you buy a piece of furniture, you are not likely to purchase another one in the short term. Amazon also shows similar products based on what is frequently purchased by their customers, known as the "Amazon choice" - a mass product with the lowest price and decent quality. Additionally, if you have searched for a product and added it to your cart but haven't purchased it, Amazon will remind you of your interest, especially if the item is still in your cart. While these strategies do not require machine learning, more sophisticated recommendation strategies can be used to personalize and improve success rates.

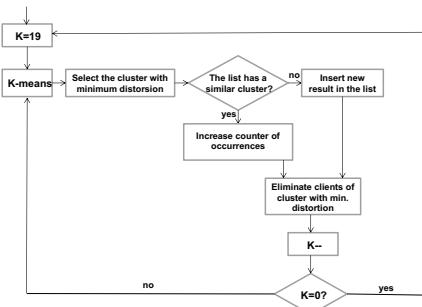
Other examples of successful data-driven business process re-engineering can be found in the slides. The German World Cup in 2014 is credited to data analytics, as they used video analysis of players to reduce the average possession time of the ball, resulting in a faster game and ultimately winning the World Cup.

In-House vs. Outsourcing Analytics

examples – PAM

- Implementation and testing of a customer segmentation model along the following dimensions:
 - Purchasing habits (spending and visits)
 - Price sensitivity
 - Lifestyles
 - Clustering
 - Strategic comparison between HI-LO and EDLP
 - Sales prediction models
 - Assortment optimization models

Analyses have been performed on PAM – Panorama receipts in 2013-2018 time frame.



- The complexity of k-means grows exponentially with k
- With k=10 it converges in 1 hour on an entry-level server, with k=11 in one day, with k=12 in one year...
- However, the "best clusters" with minimum distortion are found quickly and an analyst can easily get a sense for a "good" value of distortion with a given data set

In the case of the supermarket PAM, customer segmentation algorithms have been implemented based on dimensions such as purchasing habits, price sensitivity, and lifestyles. Instead of manually segmenting customers, PAM decided to use clustering algorithms, like

K-means, to group customers into clusters. However, K-means does not provide the optimal number of clusters (K) as an output, so PAM had to determine the appropriate value for K. They developed an algorithm to make K-means more scalable and converge to a specific K value. This algorithm was implemented using the Python pandas libraries.

Life Style	Cluster	%Students	%Experience	%Low	%Medium	%High
Cherry pickers	Promotions	5.85	3.48	2.18	51.46	46.36
Price sensitive	Low price	7.01	6.65	50.56	44.84	4.61
Loyal to brand	Low-cost and private-label	7.06	6.65	50.56	44.84	4.61
Fresh food	Private-label	9.17	13.46	8.04	78.29	13.67
	Meat and fish	9.22	10.05	1.88	57.35	40.77
	Fruit and vegetables	6.98	8.91	16.75	71.57	11.68
Social	Entertainment and high calories	3.02	2.18	9.43	61.87	28.7
	High calories	3.81	3.23	7.06	57.08	35.86
Health enthusiast	Health and diet	3.92	3.72	4.27	64.13	31.6
Fast cuisine	Quick to cook	6.77	7.44	8.46	71.39	20.15
	Ready to eat	4.34	4.21	9.17	69.04	10.86
Young families	Kids	3.75	2.63	10.55	55.55	32.86
Traditional	Basic ingredients	3.7	1.93	5.01	52.63	42.35
	Preparations	4.33	3.63	20.03	66.44	13.54
	Seasonal	3.05	1.36	1.47	45.95	52.58
Creative cuisine	Gourmet	2.43	2.31	2.94	51.31	45.75
	Regional	2.16	1.94	4.23	65.79	30.03
	Exotic	2.36	1.63	9.43	67.26	23.28
Average customer	Average customer	10.69	13.78	3.63	78.1	18.27

The result of applying K-means to customer lifestyles is shown in the visualization. For example, there is a cluster called “health enthusiasts” who purchase health and diet products more frequently than the average customer. This information is valuable for providing personalized recommendations that align with the interests of each customer cluster.

The insourcing trend

The complexity of big-data related choices and analysis activities drives companies towards insourcing, with the following goals:

- Work with IT to identify the technical solution that best fits organizational requirements: this may also involve insourcing and consolidation of data centers (e.g. GM has recently consolidated 20 outsourced data centers into 1 internal data center to «save money»)
- Identify the competences needed to set up an internal group that:
 - performs the analyses of data and works with reference people from multiple organizational functions to tie the analytics to the business needs (requirements management)
 - works with management consultants to use specific analytics to facilitate organizational change (risk and change management)
 - possibly coordinates with smaller consulting companies to integrate ad hoc services with mainstream business needs (contract management)

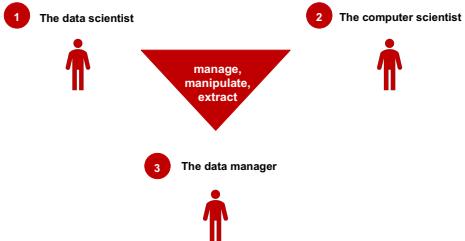
To achieve highly personalized consulting and successful implementation of analytics, companies globally, including Italy, have started to in-source their analytics capabilities. Instead of outsourcing, they hire individuals with technical backgrounds to run analytics in-house. They may also work with management consultants to facilitate organizational change and assist with deployment and system integration. In-sourcing offers several advantages, such as consolidating data centers and gaining better control over resources. It also provides improved access to qualified human resources and faster response times to organizational needs. By having in-house competencies for big data analytics, companies can tailor their analytics approach to their specific needs and leverage their long-term knowledge and relationship with the company, which often gives them a competitive edge.

Outsourcing in Information Systems

In the field of analytics, there are many benefits to running the analysis internally rather than outsourcing

ing. When companies outsource their analytics, they often receive standardized reports that may not be tailored to their specific needs. This lack of personalization can be attributed to the fact that consulting companies, which provide outsourcing services, have their own business goals, such as growing in size. As a result, they tend to use templates and standardize their analytics and reports.

Another issue with outsourcing is the level of trust in external information. If the same company that is running the analysis is also providing the solutions, there can be a conflict of interest. For example, if a company hires a consulting firm to do reputation reports and that same firm is responsible for improving the company’s web presence, there may be a bias towards optimistic results that may not accurately reflect the company’s reputation.



Furthermore, implementing real-time business intelligence requires a close relationship with the business itself. It is crucial to be able to quickly translate business needs into action. In a typical data science group, there are three main profiles: data scientists, computer scientists, and data managers. Each profile has its own strengths and limitations. Data managers excel at managing data and data-related platforms but may lack software development and algorithmic skills. Computer scientists are familiar with algorithms but may have limited business knowledge. Data scientists have better business knowledge but may lack computer science skills. Finding and retaining individuals with the necessary technical background can be challenging due to a chronic skill shortage in the field.

“Buy” the infrastructure, since:

- It significantly reduces the time required to complete a big data project
- The loss of technical competences is limited

“Make” data management and analyses, since:

- Data analyses are recognized to be strategic
- Analytics are not a commodity yet and the tailor-made approach often provides an edge

Despite these challenges, outsourcing is sometimes inevitable, especially considering the historical trend of outsourcing in information systems. Companies initially outsourced their data centers, followed by the outsourcing of processing capacity, software development, system integration, and testing and validation. Each step of outsourcing resulted in the loss of specific competencies, such as infrastructure management, software development, and data and process competencies. However, it is important to recognize that outsourcing too much can lead to a loss of control and

understanding of the external suppliers' offerings.

In conclusion, while outsourcing can be a solution to address skill shortages and resource limitations, it is important to carefully consider the potential drawbacks and ensure that the level of outsourcing aligns with the company's needs and goals.

Cloud Computing and Vendor Lock-In

Google PAS and Amazon AWS address every imaginable need:

- Computing capacity
- Storage and databases
- Networking
- Big data
- Data transfer
- API platform and ecosystem
- Internet of things
- Cloud AI
- Management tools
- Developer tools
- ...

Cloud PAS becomes a **super convenient one-stop shopping** for both:

- Hardware and
 - Software,
- with a consequent conflict of interest.
In addition to a loss of competences, it represents an oligopoly (2 players is almost a monopoly), which in the long run typically causes lower quality and higher costs.
- Diversification** (as opposed to a one-stop shopping) is the only way to mitigate risks.

In the IT business, it is crucial to have control over your suppliers, as the industry is non-standard and not as simple as purchasing toothpaste. If you cannot ensure the quality of what you purchase, you risk losing both your competitive edge and your process competencies. Cloud computing poses a threat in this regard, as it offers a one-stop solution for computing capacity, storage, databases, and networking, but lacks consulting services.

However, when comparing the prices of global cloud providers like Google with local European cloud providers such as Scaleway, Hetzner, or Aruba, you will notice a significant cost difference. The same server on Google can be up to 10 times more expensive than with a local cloud provider. While global providers offer proprietary software, local providers do not sell software and are slightly behind in terms of outsourcing processing capacity. They do, however, cover certain software needs, such as databases.

It is important to note that purchasing proprietary software from a cloud provider can lead to vendor lock-in, making it difficult to switch to a different provider in the future. To avoid this, many companies choose to purchase software from a third party and then install it on cloud platforms like Google or Azure. This approach allows for more flexibility and reduces the risk of being tied to a single cloud provider.

Managing Big Data Projects

When managing a big data project, companies should follow four key steps.

First, they need to define the use cases for the project. For each use case, they should prioritize those that are expected to provide the highest returns.

1. Define Your Use Cases

Companies realize the most significant benefits from Big Data projects when they start with an inventory of business challenges and goals and narrow them down to those expected to provide the highest return. The following questions help:

- Who are the key stakeholders?
- What data do they own?
- What data do they need?
- How do they evaluate the flexibility of current IT services on data?
- What type of insights would be enabled by more integrated and more readily available data?

1. Define Your Use Cases

- Select 1 or 2 use cases with clear KPIs to provide a proof of concept
- The stakeholders often raise a number of requirements in addition to analytics, such as:
 - Greater flexibility in managing data (e.g. be able to modify the data schema)
 - Lower lead time from data creation to data analysis and action (e.g. real-time BI)

Example

For example, a telecom company has opted for a multi-tenant Hadoop option, where they have defined a data schema making a distinction between attributes that can be modified by the business units and attributes that may be modified by a centralized coordination unit.

Next, they should identify the key stakeholders and determine the data they have and the data they need. If necessary, they can consider purchasing any missing data. They should also assess whether they have the necessary in-house expertise to analyze the data or if they need to hire external consultants.

Once the potential use cases have been selected, the company should choose one or two with clear APIs (Application Programming Interfaces) to develop a proof of concept.

2. Determine the Project Team

- Identify the project "sponsor" to remove obstacles, find the budget, provide organizational support, and champion the cause.
- Establish the project manager and the team. Define the roles and responsibilities of each team member.
- Understand the team's availability and resource constraints for the project.

Example

A large bank has identified the CFO as the sponsor and the CFO has taken a chance to renegotiate the data management response times of IT, in addition to providing key use cases and sponsoring large infrastructural expenses (800 TB).

After that, they should assemble the project team, ensuring that all necessary roles and responsibilities are covered.

3. Plan your project

- Specify expected outcomes in measurable business terms (e.g. increase revenues by implementing data-oriented pricing criteria)
- Determine any other quantifiable business requirement (e.g. improve data trust).
- Define what a successful Big Data implementation would look like (e.g. number of actual users).

Example

The HR dept. of a large IT company would like to equip employees with a tool that allows them to select training based on their lack of skills vis a vis desired job position. This initiative will ultimately be successful if it increases the percentage of employees updating their CVs in the HR application.

The next step is to plan the project, specifying the desired outcomes and determining the business requirements. It is important to establish measurable Key Performance Indicators (KPIs) that can be used to evaluate the success of the pilot project and potentially support further projects in the future.

4. Define your technical requirements

- Inventory all tools used today.
- Sketch the current architecture.
- Identify your data sources (internal, external, additional).
- Define your data schema.
- Design your infrastructure.
- Identify your suppliers.

Lastly, the company should define the technical requirements for the project. This involves selecting the appropriate technologies for the pilot stage and remaining flexible, as adjustments may be needed when scaling up and extending the project. It is crucial to avoid investing too much in the pilot phase that would need to be discarded or reworked during the scaling process.

Big Data Analytics - V Lecture

Solution and Case Studies Part Two

Big Data Project Management

We previously covered the importance of defining and selecting use cases, determining the project theme, and planning the project. Now, let's move on to step four: defining the technical requirements.

4. Define your technical requirements

- Inventory all tools used today.
- Sketch the current architecture.
- Identify your data sources (internal, external, additional).
- Define your data schema.
- Design your infrastructure.
- Identify your suppliers.

When defining the technical requirements, it's crucial to prioritize the business needs before considering the technology. It's recommended to have a clear understanding of what you require during the pilot stage. This means avoiding the purchase of unnecessary infrastructure and technologies at the initial stage. Typically, a pilot requires a smaller infrastructure and a limited set of technologies.

Once the pilot stage is successfully completed, and you are ready to scale up and deploy the project, that's when you should invest in a full-fledged infrastructure and architecture that meets your needs. By following this approach, you can ensure that your big data project progresses efficiently and effectively.

Case Study of Targeting

1. Online recommendation engine
2. Assortment optimization engine (personalized shelf)
3. Personalized online search engine
4. Personalized shopping list
5. Couponing engine (with personalized pricing)
6. Personalized communication engine (mailing, flier, pop-ups, ...)
7. In-store proximity recommendation engine
8. Online and in-store instant promotion engine (with personalized pricing)
9. Real-time access to big data

In this case study, we will explore the concept of targeting, which encompasses more than just the recommendation engine used in retail. Targeting involves automating various functionalities using big data and analytics. While the online recommendation engine is a part of targeting, there are other functionalities as well.

One example is the assortment optimization engine, which allows customers to have a personalized shelf where they can easily find products that are preferred by certain customers or even a specific customer. Another functionality is the personalized online search engine, which prioritizes products that are similar to

the ones the customer likes or prefers. Additionally, there is the personalized shopping list feature, which automatically creates a shopping list based on the customer's preferences.



PERSONALIZATION enables a variety of options:

1. Coupons are generated batch and sent via email (to be printed/shown on smartphone/activated on Web site) BEFORE a customer's next shopping experience.
2. Customers can CHOOSE to which item to apply a coupon within a set of preselected items.
3. Customers are shown INSTANT COUPONS based on cart content.
4. Coupons are automatically applied and NOTIFIED to customers.
5. Products can be BUNDLED in different ways on one coupon (e.g. up-sell, cross-sell, agreements with suppliers etc.).
6. Special coupons can be generated for CLICK&COLLECT.
7. ...

The coupon engine with personalized pricing is another aspect of targeting. It provides customers with coupons based on their preferences for their favorite products or for products that represent an upselling opportunity. For instance, it may offer a coupon for a better quality wine to encourage customers to switch to a higher quality product.

The personalized communication engine ensures that individual customer preferences are taken into consideration when sending out mailings, flyers, or pop-ups. Lastly, the instore proximity recommendation engine provides customers with instant discounts or suggestions based on the products they have already placed in their cart while shopping in a supermarket.

As you can see, targeting is not limited to recommendations alone. It encompasses a wide range of applications that utilize customer knowledge and the same engine to enhance the overall customer experience.

Personalization in Retail

- Current targeting starts from the idea of showing personalized content, assuming that this is in and of itself good. But what if this shifts customer behaviour towards making less money, indiscriminantly, for too many products?
- We start from the idea that targeting should be based on business objectives and use personalization in different ways to reach business objectives.

- Business objective:
- revenue
 - percent margin
 - cumulative margin
 - quantity
 - a *balanced mix* depending on the customer
 - ...

When considering personalized recommendations in retail, it's important to recognize that not all companies can follow the same approach as Amazon. While Amazon recommends widely purchased products, such as the Amazon Choice, for items in your cart, this strategy may not be suitable for all businesses. For example, if you are a supermarket competing on quality, recommending the most frequently purchased product may not align with your brand positioning.

By solely recommending mass-market products, even to customers who are willing to purchase higher quality items, you risk negatively impacting your business's bottom line. Non-personalized recommendations can lead to reduced margins and revenue. Therefore, it's crucial to tailor recommendations based on the specific needs and competitive position of your company.

Example: upsell, margin



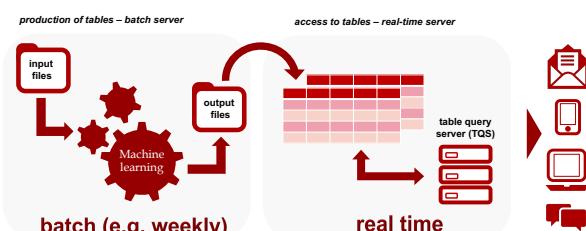
For instance, let's consider the example of upsell. If a customer typically purchases the lowest-priced lemons, a personalized recommendation engine should not suggest higher-priced organic lemons. The price difference between the customer's usual choice and the organic lemons is too significant. However, recommending Sorrento lemons, which have a higher margin, could potentially generate greater profits, even with a small discount. By offering a better product to the customer and hoping they make the switch, you can increase your revenue.

Example: crosssell, revenue



Similarly, if a customer buys mass-market pasta, they would require mass-market sauce. However, if they purchase premium or organic pasta, it would be more appropriate to recommend a sauce with similar characteristics. This level of attention to detail in personalized recommendations can drive higher revenues and profits for your business. By analyzing customer data and making these nuanced suggestions, companies can maximize their earning potential.

Architecture Considerations



- The batch component can be deployed on premises or in cloud.
- The real-time component should be deployed on premises to minimize latency.
- What is the TCO of the architecture and what the ROI from targeting?

The solution provides measurable results, leading to

increased sales and customer satisfaction—a win-win situation for companies. Architecture considerations are also important, especially when dealing with highly personalized systems that require intensive computation. In such cases, companies often generate large recommendation tables periodically, using batch processing on commodity servers. These tables, which can be as large as 300 gigabytes, are then accessed in real-time using high-performance NoSQL key-value databases. This architecture allows for efficient and effective processing of recommendations.

Conclusions and Change Management

- Big data is getting bigger: need for scalable and inexpensive solutions
- Start with basic analytics looking for quick fixes
- Experiment with advanced analytics looking for quick fixes
- Start on a longer term change program when big data projects have reached consensus with many stakeholders

In conclusion, the field of big data is continuously improving, with the size of data increasing. To effectively manage this data, scalable and cost-effective solutions are necessary. It is important to consider the business benefits and find a case study where these benefits are evident. Experimentation is crucial, as companies need to adopt an innovative approach and be open to change. This requires a shift in company culture, especially if the organization is accustomed to standardization and control. Change management is essential and goes beyond technology implementation. Specialized consultants can assist in managing organizational change and facilitating the transition. However, finding reliable change management consulting companies can be challenging. Smaller consulting firms often offer valuable expertise in this area. This concludes the discussion on big data and analytics.

Closing Remarks

As we reach the end of this course, I wanted to take a moment to provide some closing remarks. This final class has been pre-recorded to allow you additional time to study and adequately prepare for the upcoming midterm. I hope that you have found this course informative and engaging, and that it has provided you with valuable knowledge and skills. I encourage you to continue your studies and apply what you have learned in your future endeavors. Thank you for your participation, and I wish you a pleasant evening.

Agile - I Lecture

Introduction

Welcome to this ten-hour course where I will guide you through the objectives, my background, and the three main topics we will cover. Throughout this course, we will explore basic concepts of Agile and Methodologies, Microservices Architectures, and DevOps techniques. Please note that the goal of this course is not to make you an expert in these areas, but rather to provide you with a solid understanding of the fundamentals. Let's dive in!

als with different skills and levels of seniority. However, by implementing agile methodologies, you can create a cohesive team that works towards a common goal.

In my current project, I am working with a team of 52 people, and I can attest to the difficulties of organizing such a large group. Each person has unique skills and experience levels. Junior team members require clear objectives and guidance, while senior team members may possess extensive knowledge and expertise. The key is to foster a collaborative environment where everyone is aligned towards a shared objective. Agile methodologies, which we will explore in detail, provide valuable insights into organizing and managing successful teams.

Topics Overview

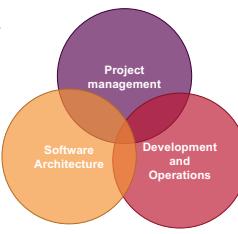
Agile Methodologies

My main objective is to provide you with a vocabulary that you can share and use when discussing these topics with experts. By understanding these concepts, you will be able to engage in meaningful conversations with others. Now, let's dive into the topics.

Introduction

Three topics that an enterprise should consider if wants to be competitive

- **Project management:** how to organize projects and people working at them → **AGILE**
- **Software Architecture:** how to design information systems to better support enterprise processes → **MICROSERVICES**
- **Development and operations:** how to design the software lifecycle management process to be effective and fast → **DEVOPS**



The first topic is project management, which is crucial for organizing and coordinating a team with diverse skills and mindsets. This can be a challenging task, especially when working on large enterprise projects. I have personal experience working on such projects with major Italian companies, and I believe that project management is a key factor for success.

The second topic is microservices architecture, a popular technological approach used in designing complex enterprise applications. This architectural paradigm is widely adopted in the industry today.

Lastly, we have a methodology that encompasses various techniques and regulates the entire software lifecycle. This methodology guides the development process from the initial stages of writing code to the final deployment of the application in a production environment.

These topics are highly relevant in today's industry, and I have found them to be crucial in my own experience. Project management, in particular, plays a significant role in organizing teams and ensuring their success. It can be challenging to bring together individu-

Microservices Architecture

Does anyone here have experience with agile methodologies, such as Scrum? Have you had any training or introduction to this methodology? I understand that some of you may already be familiar with certain topics, but I will provide examples to ensure everyone understands. I will also compare this methodology to another one to allow for comparisons between the two.

Now, let's discuss why I believe agile methodologies are beneficial. Have any of you worked with agile methodologies before? Perhaps you have used them in your own projects. Was it easy to implement? Most likely not. This is one of the challenges of agile methodologies. While the concepts are relatively straightforward and easy to understand, it can be difficult to apply them effectively. Even for those who appreciate the methodology, there can be challenges in becoming a proficient implementer.

The second topic I want to address is more technical in nature. In our previous session, we had two groups of people with different backgrounds.

DevOps Techniques

In the classroom, there were two types of people: those who wanted to become proficient developers or software architects, and those who aspired to be managers in future organizations. While the majority of attendees were managers, it is important for them to have knowledge of technical concepts as well. Working with a manager who lacks understanding of technology can be challenging, as they may not be able to effectively lead and make informed decisions. Elon Musk, a well-known manager, is an example of someone who understands the importance of technical knowledge. He is part of the technical team designing rocket engines, demonstrating that a good manager should have a grasp of what their team is doing.

Managers should at least have a basic understanding of concepts such as design patterns and different architectural paradigms, like microservices versus monolithic applications. While both paradigms have their pros and cons, for larger applications, microservices can be a successful solution. Additionally, agile methodologies, a technique developed by developers, address the challenges of managing software deliverables across different environments. This toolchain enables a faster time to market and ensures efficiency in the development process.

In today's fast-paced world, it is crucial to be effective and quick in delivering software. The discussion will further explore why speed is essential in the current landscape.

Personal Background and Experience

First and foremost, I have a personal connection to this place as I studied here and have fond memories of attending chemistry lessons in this very room. After completing my studies, I worked as a researcher in a laboratory for eight years. Eventually, I joined a company called Web Science, starting as a developer. As a technical person, I still actively engage in development work using my integrated development environment.

During my time as a student, I had the opportunity to know Professor Chiara Francalanci. She approached me to provide you with direct access to someone who works on enterprise-class projects. These projects cater to both Italian and international clients, including major organizations. It is worth mentioning that our company was recently acquired by a multinational German company, making us a part of their organization.

Project Management and Agile

Agile Methodologies

Our mission is to expand into the Italian market, so both companies have expressed interest in establishing a presence here. When I refer to big projects, I mean projects with budgets ranging from 5 million to 15 million euros each. These projects typically involve the development of a single application, which could be a critical component for businesses, such as an e-commerce platform for an airline. It could also be software that supports core processes or regular applications.

My expertise lies in working sustainably and in a relaxed environment whenever possible. As a team, we utilize state-of-the-art technologies like microservices architecture and heavily rely on cloud services. If you're unfamiliar with using the cloud, it means leveraging services provided by cloud providers like Ama-

zon. Instead of purchasing and maintaining hardware, you can buy services or components known as platform as a service. These components allow you to build your own applications without reinventing the wheel.

While our main focus is on project management and software architecture, the topic of managing people working on projects is also intriguing. Why is there a need for a change in the way we manage project teams today? Why are the methodologies developed during the industrial era no longer effective? Some companies still operate like well-oiled machines, with defined processes for every task. However, the market is evolving at a much faster pace than before. If we take the example of designing a car, in the past it would take around 10 years from conception to market launch. Nowadays, we have to design a new car in just 2 or 3 years.

This is where agile methodologies come into play. They originated from lean development principles, which were pioneered by Toyota to streamline the process of designing, building, and assembling cars. Modern companies are more like organisms, with no rigid processes dictating every aspect of their operations. Instead, they function like cells. Each cell is given an objective and has the freedom to organize itself to achieve that objective. Cells can collaborate with one another, create sub-cells, delegate work, and operate independently. This flexibility is better suited for a rapidly changing environment, as it allows for adaptation and innovation.

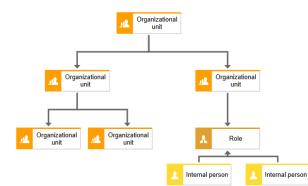
In nature, animals that cannot adapt to changing conditions face harsh consequences. Similarly, modern businesses must embrace agility to thrive in today's dynamic market.

Waterfall Model

And this is what is happening to some companies that go through this phase, leading to bankruptcy. For example, in the US, only two companies, Ford and Tesla, have never declared bankruptcy in their history. All the other companies have failed at some point. The automotive industry is a prime example of how rapidly things are changing nowadays. Let's analyze how these legacy companies are organized.

Some principle of enterprise organization

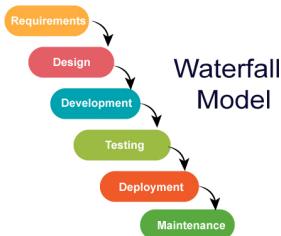
- Clearly define tasks and roles, adopt delegation as a principle.
- Search for continuous process innovation, implement efficient and standardized processes.
- Define performance and control indicators.
- Establish and share objectives, from general to operational, from systemic to individual.
- Measure and incentivize based on objectives.
- Implement communication, coordination and reporting systems, develop information systems.
- Properly manage priorities and workloads.
- Pursue continuous improvement.



The principles of organization in these companies are simple and reasonable. They have defined roles within

the company and delegate tasks to different individuals. They focus on continuous process innovation and measure the performance of these processes. Objectives are established and shared, from higher abstract objectives to more statistical and individual ones. Incentives are based on meeting these objectives. Coordination and reporting systems are in place to facilitate decision-making. Priorities and workloads are managed to ensure the company focuses on the most important tasks. Continuous improvement is also emphasized. This hierarchical organizational structure means that there are different levels within the company, with individuals at higher levels making decisions and those at lower levels carrying out the work.

In these companies, you will often see charts indicating the timing of projects, such as Gantt diagrams. These diagrams help to organize and visualize projects, with specific dates assigned to each task. However, it's important to note that these predicted timelines are not always accurate, especially for new projects or projects with uncertain requirements. Predicting the delivery date of a project without knowing all the details is challenging and often leads to inaccurate estimates. While experienced artisans may be able to predict timelines for familiar tasks, it becomes more difficult when dealing with unknown variables and client requirements.



To manage projects in a more organized manner, companies often use the Waterfall Model. This model follows a logical sequence, similar to how God designed the world in different phases. The process involves gathering requirements, designing the project, developing it, testing for bugs, deploying it, and then maintaining it. This model allows project managers to easily organize teams based on their specific expertise required at each phase.

However, this traditional organizational model is no longer as effective as it once was. There are two main reasons for this. First, the initial understanding of the project by the customer may be flawed or incomplete, leading to miscommunication and incorrect requirements. Second, the handoff between different roles in the project can result in a loss of information and understanding, leading to a final product that does not meet the customer's true needs.

To illustrate this, imagine a customer who wants a simple swing. However, due to a lack of domain knowledge or uncertainty about the business model, the customer may explain the requirements with mistakes or



unnecessary functionalities. The project leader may then simplify the requirements further, leading to a misinterpretation of the customer's needs. The analyst, who is responsible for designing the project, may make further assumptions and create a design that may not be feasible. The developer then receives this design and tries their best to implement it, but it may not align with the customer's true requirements. This lack of clear communication and understanding continues throughout the project, resulting in a final product that is far from what the customer actually needed.

This traditional organizational model may seem efficient on the surface, but it often leads to costly outcomes for the customer and lacks long-term support. It is crucial for all individuals involved in the project to have a holistic understanding of the project and work together to ensure the customer's true needs are met.

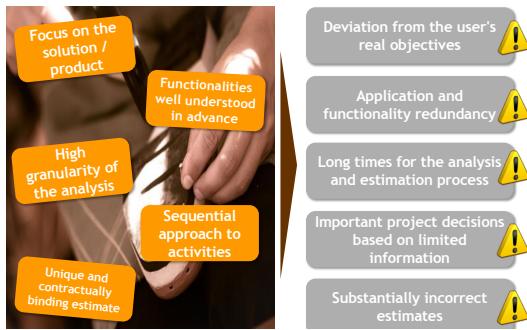
Agile vs Waterfall

In traditional project management models like waterfall, there are limitations that prevent teams from reaching their full potential. In these models, team members are often assigned tasks without considering their individual strengths and expertise. This approach may be efficient, but it fails to recognize that humans are not machines. This problem becomes more prevalent in larger companies, where there are many high-level roles with defined responsibilities. These roles often create unnecessary overhead and do not add much value to the company. This situation can be frustrating and even comical, but it is a reality that many companies face.

Fortunately, companies that want to survive and thrive understand the need for change. They are adapting their mindset and embracing new approaches. Companies that resist change and stick to outdated models often face bankruptcy and failure.

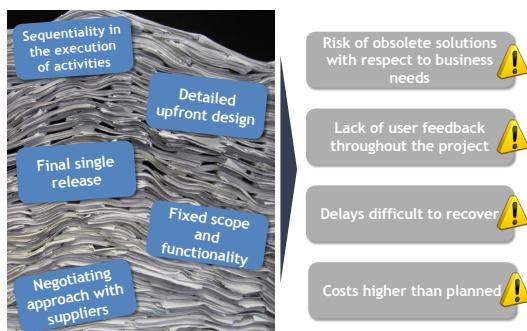
Now, let's analyze the features of the waterfall model. One positive aspect is that it focuses on the end product and ensures that all functionalities are well understood in advance. However, there are drawbacks to this approach. For example, it requires analyzing every detail of the project, even aspects that may change or become irrelevant over time. This level of detail is

Waterfall: analysis and planning

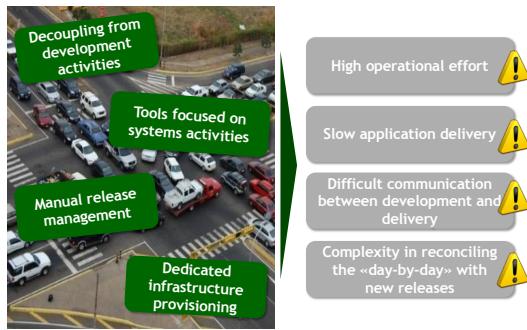


unnecessary and can be a waste of time and resources. Additionally, the waterfall model follows a sequential process, which makes it difficult to adopt agile methodologies.

Waterfall: design and development



Waterfall: management in operation



Agile methodologies face resistance in companies because it is easier to define a fixed scope and timeline for a project. Customers often want to know exactly what they will get and how much it will cost. However, for innovative projects and software development, a fixed scope, price, and timeline are not realistic. These variables cannot be fixed together. One of them will inevitably suffer.

One negative effect of fixed contracts is that developers tend to focus on delivering what is written in the contract rather than what the client actually desires. This can lead to deviations from the user's objectives, redundant functionality, and errors that persist throughout the project.

Another drawback of the waterfall model is the extensive time spent on analysis. There is a saying in America that goes, "If you need to analyze everything,

you won't finish it." Over-analyzing can lead to paralysis and delays in starting the development process.

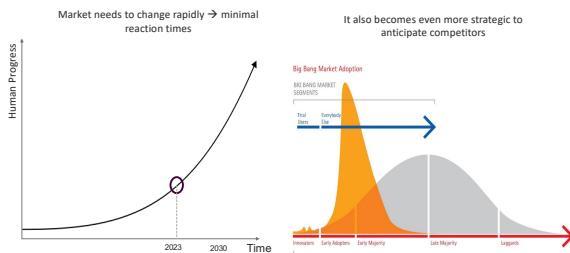
In contrast, agile methodologies emphasize making decisions as late as possible. This allows teams to gather more information and make better-informed decisions.

Iterative Approach

Being late is not ideal, but it's better to analyze functionality closer to the implementation phase rather than upfront. It's not useful to analyze something in detail that won't be developed for months. If something changes in the world, users may no longer want that functionality, but developers will still implement it because it's in the contract. It's difficult to recover delays without changing the scope, which refers to the list of functionality the application should have. Projects often end up costing more than anticipated.

During the operational phase, there is a high operational effort because developers had the opportunity to reduce the scope and create higher quality software. However, they are still expected to implement all the functionality on time, even if they are behind schedule. To compensate, developers may reduce the quality or use workarounds. This approach leads to technical debt and introduces bugs in unexpected places due to poor software architecture.

Why it is necessary to reduce the Time to Market

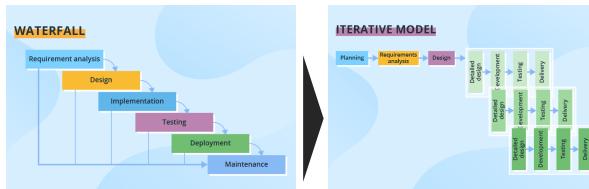


The need to move faster is driven by the exponential progress of human society and the changing nature of innovation. Unlike in the past, where technologies had a lifecycle of discovery, adoption, and dismissal, today's world is different. Agile companies can disrupt markets with new products, even if they are not legacy companies. For example, the iPhone disrupted the market dominated by solid companies like Nokia and Sony Ericsson.

Given the complexity of projects and contexts, it's impossible to predict everything in advance. Instead of trying to plan everything upfront, it's important to continuously adapt the plan as things unfold. This requires agility and an iterative approach, moving away from the traditional waterfall project management method. The transition to this approach has been happening gradually over the past 15 to 20 years.

Practical Example

An agility that we can gradually achieve



In a more iterative approach, you still plan and gather requirements, but instead of designing every functionality upfront, you focus on what you will develop in a shorter period of time called an iteration. To illustrate the difference between these methodologies, let's use the example of renovating a home.



In the traditional approach, you would conduct a complete upfront analysis of your needs and expectations. You would benchmark different contractors, do upfront design, and detail every item in the contract. You might even start thinking about finishes and furnishings, and begin purchasing items from IKEA in advance. While this may seem reasonable, it can lead to mistakes and inefficiencies.

In the iterative approach, you still plan everything and select materials, but you start implementing the work in smaller increments. You periodically check the progress, but because everything is defined upfront, you don't need to be present every day. You can visit the site after a week or even a month. The final review and testing occur during the delivery phase.

Now, let's consider what happens during the traditional approach. Your contractor estimates that the job will take 12 weeks and cost 100,000 euros. However, after three weeks, some defects are discovered that couldn't have been predicted. Incorrect calculations and the need for different materials arise, causing delays and additional costs. After three weeks, there is already a two-week delay and an extra cost of 5,000 euros.

As the project progresses, the delays and additional costs accumulate, causing the project to go over budget. To try and stay within the original contract, the contractor may resort to using shortcuts or lower-quality materials. The end result may not meet your expectations.

By contrast, an iterative approach allows for more flexibility. It enables you to adapt to unforeseen issues and make adjustments along the way. This approach focuses on delivering smaller increments of work, allowing for more efficient problem-solving and reducing the risk of going over budget.

In summary, the iterative approach offers a different perspective on project management, emphasizing adaptability and flexibility. It allows for adjustments based on real-time feedback and helps mitigate the risks associated with upfront planning.

Feedback and Iterations

To implement a different approach in project management, it's important to find a contractor who is willing to work using an agile methodology. This allows for more transparency in project estimation and cost. By working together as a team, the contractor can start the project by performing initial tasks and gathering valuable data. After the first iteration, the project plan can be adjusted based on the new information discovered. This iterative process ensures that the project stays within budget and meets any time constraints. Instead of following a predefined plan, the focus is on adapting and making changes as needed throughout the project. For example, during the second iteration, the scope can be adjusted to prioritize the most important tasks and reduce costs. Collaboration with the team can lead to better decisions, such as moving walls for easier furniture placement or optimizing electrical socket placement. Unexpected challenges, like the need to replace lead pipes, can be addressed in subsequent iterations by reallocating resources from less essential areas. By working in iterations, the project can achieve the desired outcome more efficiently and cost-effectively. The use of Scrum, a popular agile framework, helps protect the development team by providing clear goals and functionality to be implemented within each iteration. Scope discussions are reserved for the end of each iteration, ensuring a focused and productive workflow.

Cultural Shift and Adoption

Okay, there's a change of the objective through the iteration, but during the iteration, the team (and their work) is protected. This concept is related to the discovery of needs, which is not typically considered in waterfall projects. In waterfall projects, needs are often ignored or not listened to because they are seen as detrimental to the project, causing delays. This can lead project managers to become closed off and unwilling to listen to others.

In agile methodologies, however, there is a continuous refinement of plans and a focus on improvement.

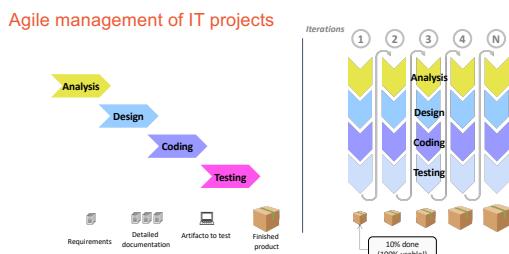
For example, instead of starting work in every room, you may start with a less important room to gain experience and learn from any mistakes without causing major issues. Teamwork is essential in this methodology.

So why weren't these simple concepts used in the past? Nowadays, they are more widely adopted, but there are still companies clinging to the traditional model. The problem lies in cultural factors. In my career, I have conducted many workshops with companies to teach them agile methodologies. Often, it is the employees at the lower levels of the hierarchy who are most eager to adopt these methodologies because they see the improvements it brings to their work. On the other hand, there are middle managers who fear that their roles will become obsolete. In some cases, middle managers were not actively contributing to projects but were only distributing messages, knowledge, and complaints. When these companies transition to agile methodologies like Scrum, for example, they realize that there are only three roles: developers, Scrum Masters, and Product Owners. Many middle managers see their jobs at risk because they were only needed to write emails and give orders, not actively participate in the project.

Resistance to agile methodologies also stems from the fact that it removes the ability to hide within the organization. With agile, everything becomes more transparent and visible to managers. This can create a sense of pressure and the need to perform at a higher level. In the past, employees may have done just enough to survive within the company, but with agile methodologies, this is no longer possible.

Initially, agile methodologies were only used by a few development teams, as there was no widespread need for agility based on business needs. However, as business people began to understand that agility is crucial for survival, they started implementing agile methodologies after 20 years. It's a shift that is happening now.

Agile in Modern Business



In traditional project management, the finished product is only delivered at the end of the project. However, with agile methodologies, you can deliver a portion of the product after the first iteration. This allows you to receive feedback early on and make necessary adjustments.

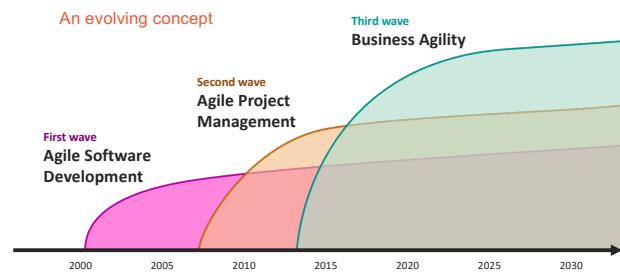
By implementing a minimum viable product (MVP) and presenting it to the customer as soon as possible, you can gather feedback and improve the product based on their input.

Startups often follow this approach, implementing a beta version of their product and iterating based on customer feedback. For example, Spotify and Facebook continuously evolved their products based on user feedback. On the other hand, NASA, following a waterfall approach, had to cancel projects when requirements were not properly detailed.

By using agile methodologies, such as Scrum, you can provide a more accurate cost estimation to clients. Instead of giving a fixed price based on incomplete information, you can offer an estimation based on the current understanding of the project. This allows for flexibility and adaptation as the project progresses.

Working closely with the client is crucial in agile methodologies. The client becomes the product owner and actively participates in setting priorities and providing feedback. This collaboration ensures that the final product aligns with the client's needs and desires.

Receiving feedback throughout the project gives you the opportunity to adjust and deliver what the client truly wants. It's important to remember that clients may have different needs and preferences as the project evolves. Agile methodologies embrace this philosophy and allow for continuous adaptation and improvement.



In recent years, agile methodologies have gained popularity and are now widely used by companies of all sizes. It has proven to be an effective way to stay competitive in today's fast-paced market. Even meetings are organized using agile techniques to ensure efficiency and productivity. Embracing agile methodologies is key to becoming faster and more efficient in our modern business landscape.

Conclusion

The secret to successful project execution lies in two key factors: having a reliable team and embracing the concept of iteration. It is crucial to have a team of dedicated individuals who are genuinely interested in the project's success. With Agile methodology, such as Scrum, you can measure the team's performance and have better control over project execution.

However, it is important to be cautious of the dangers that may arise if you have inexperienced or untrustworthy developers. Without proper control and monitoring, you may end up with a project that lacks functionality and exceeds your budget and time constraints. Therefore, it is essential to carefully select and trust your team members.

Teamwork and iteration are the other vital aspects of successful project execution. By working collaboratively and continuously iterating on the project, you can achieve better results. This approach allows for flexibility and adaptability, ensuring that the project evolves and improves over time.

In conclusion, trust in your team and embrace the iterative process to achieve success in your projects. By doing so, you can effectively control the project's execution and maximize its potential.

Agile - II Lecture

Project Management Methodologies

Waterfall vs Agile

During the morning session, we discussed two project management methodologies: Waterfall and Agile. Waterfall is a traditional approach that is still used today, especially for short and well-defined projects. It is efficient when you have a clear understanding of what needs to be done. However, for complex projects, it is better to consider an Agile approach.

Agile emphasizes the importance of having a cohesive team that is committed to the project's objectives. While each team member may have their own personal goals, it is crucial for all stakeholders to keep the main project goal in mind. Agile is not a complicated concept to grasp. Instead of rigidly fixing the scope, which refers to the list of functionalities or requirements for the project, Agile allows for flexibility. The scope can change throughout the project as needed.

In contrast, Waterfall projects typically experience changes in budget and time when difficulties or obstacles arise during the project journey. This is because the scope is fixed from the start, and any deviations require additional resources.

By understanding the differences between Waterfall and Agile, project managers can choose the most suitable methodology based on the project's complexity and requirements.

Team Dynamics and Agile

When an IT project is running behind schedule, simply adding more people to the team is not always the best solution. It may seem logical that if you have work for 10 people, hiring 10 more will speed up the project. However, this approach rarely leads to a successful recovery. There's a saying that you can't have a child in one month by having nine mothers. In other words, adding more people to a late project does not guarantee faster completion.

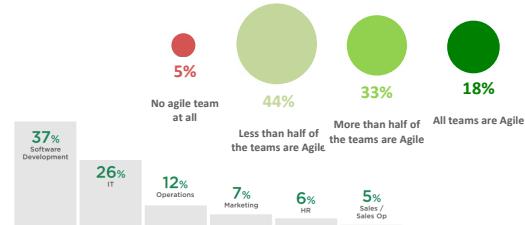
Instead, in agile project management, it's easier to please higher-level management by adjusting the scope of the project. Since they may not be fully aware of the project's complete scope, you can work with the client to prioritize the most important features and deliver them by the promised deadline, even if you're running behind schedule. This means implementing the higher-priority items from the product backlog and potentially leaving out less critical functionalities. A skilled product owner can effectively manage the product backlog, adding and removing items to help the team achieve

their iteration goals.

By focusing on the most important features and adjusting the scope, you can deliver the first version of the project on time and within the fixed budget. This approach allows for flexibility while still meeting the project's objectives.

Scope Flexibility and Budget

What is the diffusion in the world ?

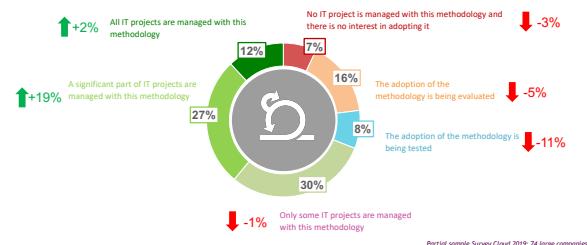


In traditional Waterfall projects, the scope is typically fixed and written in contracts. This means that even if there are minor items missing from the scope, the client may refuse to pay. To address this issue, it is important to transition from a Waterfall approach to a more agile methodology. Agile methodologies have gained popularity worldwide, although only a small percentage of companies (around 18%) have fully embraced them. While many people are experimenting with agile methodologies, only about 20% have a solid understanding of agile practices.

Agile in Practice

However, despite its benefits, implementing Agile can be challenging, especially when faced with unique project requirements. There may be instances where junior team members are unfamiliar with the methodology or clients prefer a more traditional approach. Each project can present its own set of obstacles. However, with time and experience, the team becomes more proficient in Agile practices, leading to increased efficiency.

What is the diffusion in Italy



In Italy, Agile adoption has been slower compared to other countries. Nevertheless, there are success stories

of companies that have embraced Agile and achieved remarkable results in a short period of time.

Challenges of Agile Adoption

The business world has come to realize that adopting agile methodologies is the way forward. Let's consider a small company with just five people. After completing your studies, you and your colleagues decide to start a company and take on a project. You commit to a fixed scope, fixed price, fixed time approach, and you work tirelessly, even sacrificing sleep to meet deadlines. However, as the company grows and you hire new employees who are not founders, they may not be willing to work under such intense pressure.

This is where agile comes in. By adopting an agile approach, you can reduce the risks for your company. Instead of promising a fixed scope, you focus on leveraging your team's capabilities and talents. You work closely with a product owner, who could be your client, and maintain a transparent relationship with them. This allows for better productivity and higher quality work in a more relaxed environment. By continuously listening to customer feedback, you can ensure higher customer satisfaction. Ultimately, this creates a win-win relationship between your customer and your company, resulting in a higher return on investment.

Agile has become a widely used methodology over the years, and its success is supported by various statistics. It offers a more flexible and efficient way of working, which is why it has gained popularity in the business world.

Agile and Contracting

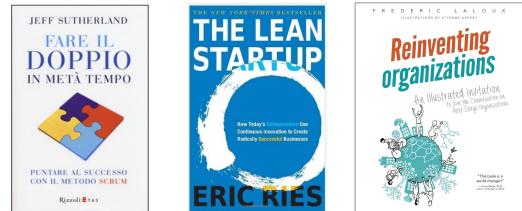
Implementing agile methodologies can be challenging, as it requires a shift in mindset rather than just technical knowledge. One of the most well-known agile methodologies is explained later in this section. Agile concepts are not technical in nature; they are about adopting a specific approach to work. While it may be easier for some to start using agile methodologies, it is important to be precise and follow the rules while respecting others involved in the project. There are certain restrictions and agreements that must be adhered to during the project. However, there may be times when fatigue sets in and these principles are not followed.

For individuals who have spent their entire careers working with different types of relationships, such as service providers and companies, or startups working for clients, these new agile dynamics may be unfamiliar. In the past, companies would often publish rankings, known as "Gara" in Italian, to select the company that would implement a project. Participating in this rank-

ing involved interviews and declaring the daily cost of developers, among other evaluations. The ranking was based on factors such as the promised delivery date and budget. This system encouraged overestimating effort, underpaying team members, and working within fixed scopes, prices, and budgets. The company ranked highest in the list would be chosen. In the public sector, this ranking system is mandatory.

Organizational Impact of Agile

Choosing a team based solely on cost rather than skill is a common but flawed approach that often leads to unsuccessful outcomes. Implementing Agile in a large organization is challenging due to the organizational repercussions it brings. With Agile, decision-making power shifts from higher-level managers to the teams actually doing the work, bypassing middle managers. This change can be met with resistance from those who are no longer needed or who must take on new roles and responsibilities. Some individuals may be hesitant to embrace Agile because it requires them to step out of their comfort zones and develop new skills. Additionally, employees nearing retirement may be reluctant to start a new career path. These factors contribute to the difficulty of introducing Agile as an organizational revolution in companies.



Many large companies have started implementing Agile methodologies gradually, beginning with side projects involving younger employees. Over time, as more projects are conducted using these methodologies, higher-level managers begin to realize the benefits. However, it's important to note that the initial projects may not always go smoothly due to factors such as resistance to change or lack of experience. Despite this, there are numerous books available that discuss the organizational transformations happening within companies.

Scrum Framework

Scrum Overview

Now, let's focus on the Scrum methodology itself. The Scrum framework can be summarized in a single slide, which I will present shortly. Before we dive into the details, it's important to understand the core principles outlined in the Agile Manifesto. These principles emphasize the importance of individuals and interactions

Agile Manifesto

We are uncovering better ways of developing software by doing it and helping others do it.
Through this work we have come to value:

- Individuals and interactions over processes and tools**
- Working software over comprehensive documentation**
- Customer collaboration over contract negotiation**
- Responding to change over following a plan**

While there is value in the items on the right, we value the items on the left more.

over processes and tools. Instead of treating developers as replaceable units of production, the focus is on collaboration and communication between team members. Additionally, working software is prioritized over comprehensive documentation, as the latter tends to become outdated quickly. Customer collaboration is crucial, as it helps build trust and avoids unnecessary conflicts. Finally, the ability to respond to change is valued more than strictly following a plan, as projects rarely go exactly as planned.

While Gantt diagrams can be useful for communicating project intentions, it's important to acknowledge their limitations. They provide a visual representation of the project plan, but it's crucial to recognize that the plan may need to be adjusted as the project progresses. Estimations can be uncertain, and unexpected changes can occur, leading to variations in scope, time, and budget. Therefore, it's essential to maintain flexibility and adaptability throughout the project.



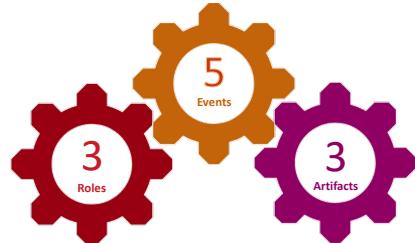
Now, let's explore some key aspects of the Scrum framework. One important principle is that the best architectures, requirements, and designs emerge from self-organizing teams. This means that the team members themselves are best equipped to determine how to implement a solution. It's not ideal for a product owner or customer to impose technical solutions without valid business or functional reasons.

In Scrum, working software is considered the primary measure of progress. Instead of relying solely on time sheets or other organizational tools, regular demos are conducted to showcase the implemented functionality. This allows for continuous feedback and ensures that progress is visible to all stakeholders.

Another crucial aspect is the daily collaboration between business people and developers throughout the project. This eliminates the traditional approach of business people providing requirements and then dis-

engaging until the project is complete. Instead, regular interactions and feedback sessions are encouraged to maintain a strong partnership.

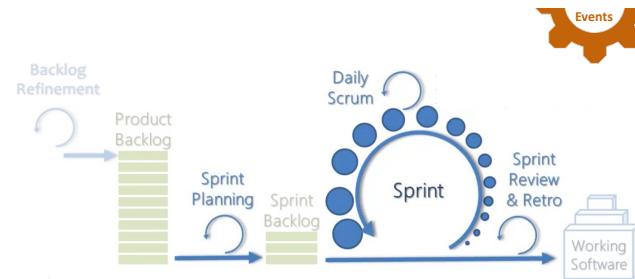
It's important to embrace changes in the product backlog, which is the list of tasks to be completed. Clients may prioritize certain features or request new ones, and this dynamic backlog ensures that the project remains alive and responsive to evolving needs.



The term "Scrum" originates from rugby, where it refers to the collective effort of the team pushing towards a common goal. In the Scrum methodology, there are three roles, five events, and three artifacts that form the framework. These elements provide structure and guidance for effective project management.

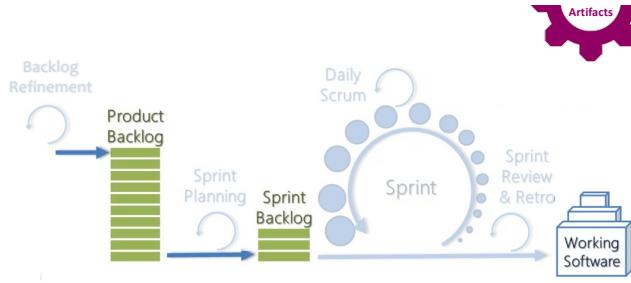
By understanding and implementing the Scrum framework, companies can benefit from improved collaboration, adaptability, and a focus on delivering working software.

The Scrum framework consists of three key roles: the Product Owner, the Scrum Master, and the Developers. The Product Owner is responsible for managing the project and has similar responsibilities to a project manager or leader. We will delve into their specific responsibilities later. The Scrum Master, contrary to the name, is not a master over others but rather a servant leader. Their main purpose is to support and assist the team in their work. The Developers, who can include various disciplines such as designers, business analysts, and other skilled individuals, are responsible for developing the product.



In addition to the roles, there are five important events in the Scrum framework. These events include Backlog Refinement, Sprint Planning, Daily Scrub, Sprint Review, and Retrospective. Each event serves a specific purpose and contributes to the overall success of the project.

Furthermore, there are three artifacts in Scrum. The



receive guidance from a higher-level product owner. However, some argue that it is better to have a single product owner, even with multiple teams, as it can be challenging for one person to have knowledge of all aspects of the project.

Within the development team, there are no recognized roles or titles. Even if someone has more experience, they are considered equal to other team members. However, due to their experience, they may be sought out for advice or guidance. The self-organizing nature of the team allows for individual growth and decision-making.



... is a facilitator, helps all roles and functions to collaborate effectively

... is a teacher / coach, "trains" the Team and the Product Owner, helping them to understand and follow Scrum values, practices and rules

... "protects" the team and educates people outside the team about the practices the team is adopting

... collaborates with the Organization to create the best working environment for the team to perform

... supports the team in removing impediments ...



first is the Product Backlog, which is a list of tasks that need to be completed. The project is considered finished when the Product Backlog is empty. The second artifact is the Sprint Backlog, which is a subset of the Product Backlog and contains the tasks to be completed during a specific sprint. Finally, the third artifact is the working software itself, which is the tangible outcome of the team's efforts.

Now, let's explore the details of each Scrum role.

Scrum Roles



- The Product Owner's primary responsibility is to maximize the value of the product resulting from the Scrum Team's work
- It defines the vision of what needs to be accomplished
- It is responsible for the effective management of the product backlog, including:
 - Create and communicate elements of the product backlog
 - Sort the items in the product backlog by their value
 - Make sure the product backlog is transparent, visible and clear
- The above actions can be carried out in person or delegated, but the PO is accountable.



The product owner plays a crucial role in maximizing the value of the product. They define the product vision and gather requirements, which may be delegated to others. The product owner is responsible for managing the product backlog, ensuring it is transparent and clear. While they don't need to know every detail, they are accountable for making sure the backlog is understandable to all team members. The product owner also collaborates with the team and answers product-related questions during Scrum ceremonies.



- The development team consists of 3-9 people and is cross-functional
- It has all the necessary skills to create a "Potentially Shippable Product Increment"
- No role or title is recognized within the development team
- The Team is self-organized
- The team is "empowered" to find the best solution



The development team consists of cross-functional members, typically ranging from three to nine people. In larger projects, multiple Scrum teams may be created, with each team having its own product owner. The product owners collaborate with each other and

The Scrum Master is responsible for facilitating the Scrum process and ensuring its effectiveness. They act as a coach and support the team in removing any obstacles they may face. The Scrum Master may have non-technical skills and can analyze team performance and track project progress using metrics like burn-down diagrams. Their role is separate from the product owner to maintain a clear distinction between project scope and team needs.

The Scrum Master's role is important because they have a broader view of the project and can provide guidance without being directly involved in the day-to-day development. This separation allows them to protect the team from any changes in functionality or priorities that may conflict with the agreed-upon scope. The Scrum Master acts as a coach, similar to how a coach in a sports match does not play alongside the players.

In Agile methodologies, the product owner, development team, and Scrum Master each have their own responsibilities and work together to ensure the success of the project. The team commits to a piece of the backlog during a sprint, which typically lasts one to four weeks, and the Scrum Master ensures that all rules and guidelines are followed by all team members and the product owner.

Scrum Events

Every Sprint in the Scrum framework has a Sprint goal that is established during the Sprint planning. The typical duration of a Sprint is two weeks, and it is generally recommended not to change the duration once it is set. However, there may be cases where a Sprint

- From 1 to 4 consecutive weeks during which the team develops the Product Backlog Items (PBI) chosen during the Sprint Planning to reach the Sprint Goal
- Usually a duration of 2 weeks is selected
- Once the Sprint duration has been established, it is a good idea not to change it (unless the team decides it for a good reason)
- Changes to the Sprint Backlog during the Sprint should be avoided, unless the changes make it easier to achieve the goal, with the same product value
- No interruptions between sprints

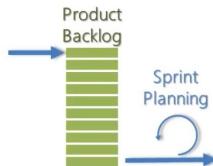


needs to be aborted. For example, if it is discovered in the middle of the Sprint that the development of a particular feature is not useful at all, it is better to stop the development rather than continue. It is important to avoid making changes to the Sprint backlog during the Sprint to minimize interruptions.

During the Sprint planning, items are selected from the product backlog and added to the Sprint backlog, which is the list of tasks to be completed during the Sprint. The criteria for selecting items from the product backlog is simple: items are taken from the top of the backlog and placed in the Sprint backlog. If there are any technical requirements that are necessary for the implementation of functional items, the team can communicate this to the product owner. The product owner usually agrees to include these technical requirements in the backlog because they are important for the functionality. The Sprint backlog is considered complete once all the necessary items have been selected.



- At the beginning of each Sprint
- Sprint Planning is time-boxed (4-8 hours)
- The entire Scrum Team participates in the Sprint planning meeting
- It is divided into two parts: the first discusses which PBIs to put in the Sprint Backlog, the second discusses how to implement the chosen PBIs

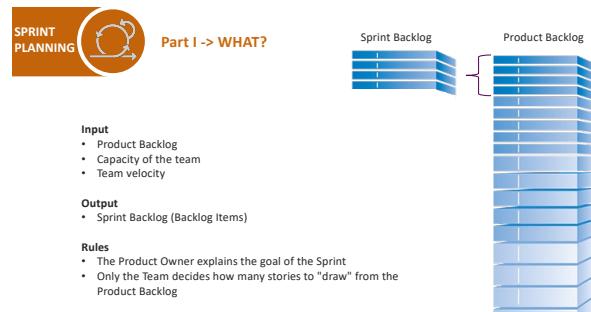


The Sprint planning meeting typically lasts from four to eight hours. During this meeting, the product owner explains the functionalities to the team, and the team estimates the effort required to implement them. This meeting also provides an opportunity for the team to discuss and contribute their ideas and expertise to the implementation of the functionalities. This collaboration helps distribute knowledge among team members and ensures that the work can continue even if someone is absent or leaves the team.

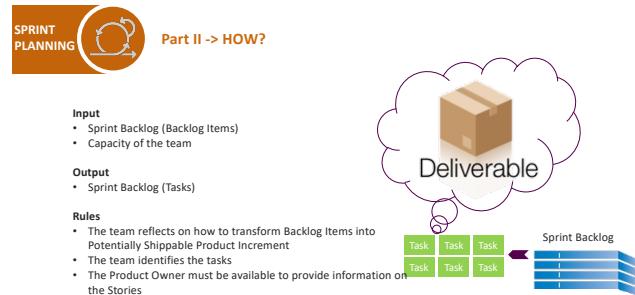
One of the benefits of the Sprint planning meeting is that it allows the team to estimate the work and determine how much can be included in the Sprint backlog. If the team realizes that they cannot complete all the planned items within the Sprint, they can remove some items from the backlog and prioritize the most important ones. Once the team commits to a scope for the Sprint, they are expected to complete it without any interruptions or delays.

Sprint Planning

During the Sprint, if any impediments or issues arise, they can be discussed and addressed in the daily Scrum meeting. The product owner can be informed about any impediments that may affect the completion of certain items, and adjustments can be made if necessary. However, it is important for the team to stay committed to the Sprint goal and complete the agreed-upon scope.



The Sprint planning meeting is the first part of the Sprint, where the product backlog is used as input to create the Sprint backlog. The team's capacity and velocity are taken into account to determine the amount of work that can be included in the Sprint. The output of the Sprint planning meeting is the Sprint backlog, which includes the selected items and their estimated effort.



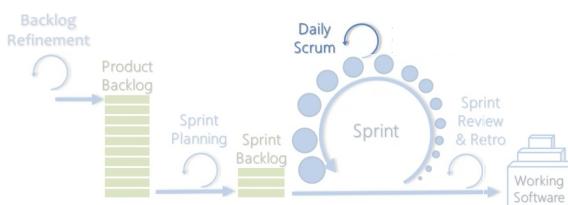
In the past, it was common to break down each item in the Sprint backlog into subtasks during the Sprint planning meeting. However, this practice is now less common and is only done if necessary for better organization or estimation. It is more common for developers to create internal tasks within each item if they need more granularity in their work. This allows for better estimation and helps confirm whether the team can commit to the Sprint goal.

The focus during the Sprint planning meeting is on the most important items in the product backlog. Time is not wasted on estimating items that are not currently being considered for implementation. This approach is lean and agile, as effort is only spent when necessary and on the most important tasks. Detailed design work is postponed until it is needed, and the team can start preparing for the next iteration by working on the detailed analysis of upcoming tasks.

In summary, the Sprint planning meeting is an im-



During the daily meeting the team organizes the day to advance towards the achievement of the sprint goal, communicates any impediments and aligns itself on the progress

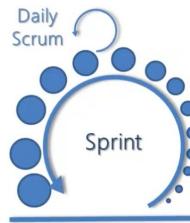


portant part of the Scrum framework, where the Sprint backlog is created based on the product backlog. The team estimates the effort required for each item and commits to completing a specific scope. The daily Scrum meeting is another crucial meeting in Scrum, where the team discusses progress, impediments, and adjusts their plan if necessary.

Daily Scrum



- The meeting has a maximum duration of 15 minutes
- There are several patterns that can be used to structure the discussion during the daily
- The Team can choose the most suitable structure, as long as the focus is on the advancement of the sprint and produces a feasible work plan



In the past, when there was less remote working and more in-person collaboration, we used a specific pattern for our meetings. We would gather in a circle with all nine team members in the same room. To regulate the discussion, we introduced a simple trick: we passed around a small ball, and only the person holding the ball had the right to speak. This helped us manage the tendency for everyone to talk over each other, which is common in Italian culture. If someone wanted to speak, they would raise their hand and request the ball. Then, they would share three things: what they had done yesterday, what they planned to do today, and if they had any impediments. Each person had a maximum of two minutes to share their updates. This format ensured that the meeting lasted no longer than 15 minutes.

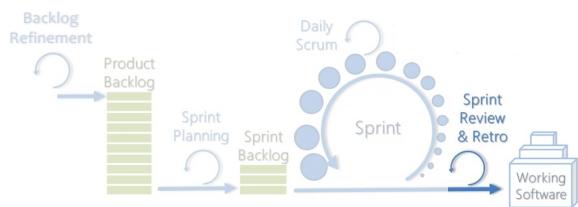
This meeting format had a powerful impact on our projects. It allowed us to quickly identify if someone was facing difficulties or impediments in their work. No one could hide their challenges, as they would be brought up during the meeting, giving the team an opportunity to offer help or for the Scrum Master to address any organizational issues. This open communication prevented situations where team members struggled for days without anyone knowing. It was a very effective way to cut waste from our projects.

Additionally, the daily meeting provided a valuable learning opportunity for junior team members who were unfamiliar with the technologies being used. They could ask questions and receive guidance from more experienced team members. This helped them learn and contribute to the project more effectively.

However, one challenge we faced with the daily meeting was that sometimes developers would start to engage in lengthy discussions, exceeding the allocated two minutes per person. This resulted in meetings that lasted longer than the intended 15 minutes. While occasional deviations were acceptable, it was important to keep the meetings concise. The Scrum Master was responsible for ensuring the meeting stayed on track and was completed within the agreed-upon time.



During the sprint review, the project is evaluated against the sprint goal defined during sprint planning. The completed items are presented to the PO that can accept or reject them asking for fixes and adjustments.



In the past, when in-person attendance was expected, we implemented a system to encourage punctuality. If someone arrived late to the daily meeting, they would contribute a small amount of money (such as one or two euros) to a collective fund. At the end of the project, we would use the collected money to organize a pizza party for the team. This practice helped incentivize everyone to be more punctual and adhere to the schedule. However, with the shift to remote working, we have adjusted our approach. Now, if someone is more than two minutes late, we start the meeting without them, ensuring that we have enough time to discuss the important topics: the sprint review and the retrospective.

Sprint Review and Retrospective



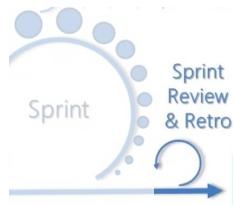
- The entire Scrum Team and the Key Stakeholders are present (in some contexts also colleagues from other departments, managers and customers)
- The Scrum Team conducts the review, showing to stakeholders what was accomplished in the sprint.
- The Product Owner accepts or rejects the various deliverables
- The Product Backlog is adapted based on the emerging feedback
- Duration: 1 hour for each week of the Sprint max



In conclusion, the sprint planning takes place at the beginning of the iteration, followed by daily work throughout the week. At the end of the iteration, there is a sprint review where the team demonstrates their



- The only goal is to grow and improve the team work and not trying to find the culprit
- During each Retrospective, the team, reflecting on the Sprint that has just ended, plans actions to increase the quality of the product, improving work processes.
- The Scrum Team, the Scrum Master, participates in the Retrospective. Even if the presence of the PO is not mandatory, it is still strongly recommended.



progress to key stakeholders. During this review, the product owner has the responsibility to accept or reject the deliverables. This transparent process helps avoid conflicts between developers and project managers. After the review, the team holds a sprint retrospective to reflect on their mistakes and successes during the iteration. They work together to find ways to improve their work and avoid repeating the same mistakes in the future. This continuous improvement philosophy is a crucial part of the agile methodology. If you have any questions, feel free to ask next Monday. Thank you for your attention.

Agile - III Lecture

Introduction to Agile and Scrum

Good morning! Let's take a moment to discuss the Agile methodology, specifically the Scrum framework.

Scrum Framework Components

Roles in Scrum

Understanding the concepts of Agile and Scrum is relatively simple, but the true value of these methodologies becomes apparent when working with a team. To fully appreciate the benefits of the Agile and Scrum methodology, it is recommended to have a team of at least seven people. This number allows for effective meetings and clear product management. Let's summarize the key elements again: three roles, five events, and three artifacts.

The three roles in Scrum are the Product Owner, Scrum Master, and Developer. The term "Developer" encompasses not only software developers but also any individuals who contribute their skills to the project, such as graphic designers.

Scrum Events

In the Scrum framework, there are several important events that help facilitate effective collaboration and progress. The three key events are Sprint Planning, Daily Scrum, and Sprint Review. Additionally, there are two other important events: Backlog Refinement and Retrospective.

Sprint Planning is a crucial event where the Scrum Team plans the work to be done in the upcoming Sprint. It involves selecting the items from the Product Backlog that will be worked on and creating a Sprint Goal.

The Daily Scrum is a short daily meeting where the Scrum Team synchronizes their work. Each team member provides an update on what they have accomplished since the last meeting, what they plan to do next, and any obstacles they are facing.

The Sprint Review is held at the end of each Sprint and provides an opportunity for the Scrum Team to showcase the work they have completed. Stakeholders are invited to provide feedback and suggest any changes or improvements.

In addition to these three events, there are two other important events in the Scrum framework. Backlog Refinement is a collaborative session where the Scrum

Team reviews and updates the Product Backlog. This helps ensure that the backlog is well-prepared and prioritized for future Sprints.

The Retrospective is a valuable event that occurs at the end of each Sprint. The Scrum Team reflects on their work and identifies areas for improvement. This event allows the team to continuously enhance their processes and increase their effectiveness.

By understanding and effectively utilizing these events, teams can maximize their productivity and deliver high-quality results in an iterative and incremental manner.

Collaboration and Communication

The reason why it is important for the methodology to make all these events mandatory is because they are valuable time investments in the project. Without a methodology like this, when you fall behind schedule, you tend to isolate yourself in front of your computer, trying to catch up on the accumulated delay. However, even if you are behind, these moments are crucial. As someone who enjoys working independently, I understand the temptation to skip these events. But coordinating with others is essential. Although they may seem like additional overhead because you are not directly developing software, it is important not to waste too much time and instead invest the right amount of time in these time-boxed events.

For example, in the daily stand-up meetings, it is important for a team of seven to nine people to keep it to 15 minutes. This way, you can quickly share what you accomplished yesterday, what you plan to do today, and if you have any problems. After the meeting, you can schedule additional discussions with team members to delve into further details. These events serve as the rules and guidelines for effective collaboration and communication within the methodology.

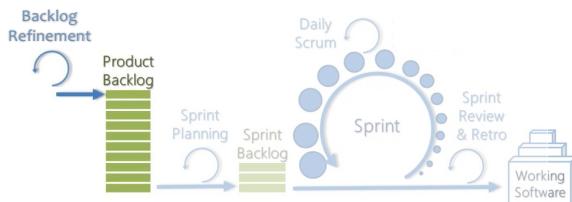
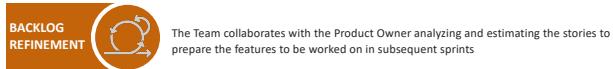
Product Backlog and User Stories

Product Backlog Management

Let's begin with the primary artifact: the product backlog. The product backlog is a comprehensive list of tasks and requirements that need to be completed in order to finish the project.

Prioritization and Readiness

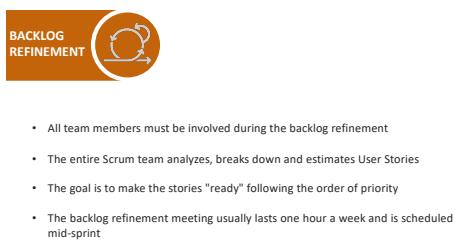
The product owner is accountable for the artifact known as the product backlog. It is their responsibility to maintain and understand the items in the backlog, as well as explain them to the development team. During



sprint planning, the product owner can ask questions about the items to ensure clarity. However, it may not be possible to analyze every item in detail during sprint planning. Therefore, it is crucial to prioritize the product backlog. The most important tasks should be at the top, while less important ones are lower down. In Agile methodology, it is important to avoid wasting time on detailed analysis for lower priority items. Instead, focus on making the top items ready for development.

User Stories and Detail Levels

When working with a product backlog, it's important to strike a balance between analyzing technical and functional details. Spending too much time on detailed analysis for items that may not be chosen for several months can be wasteful, as things can change in the meantime. This concept is known as "energy."



The product backlog typically consists of user stories, which are concise descriptions of business requirements. These stories can be functional, describing a specific functionality, or technical/non-functional, related to the technical aspects necessary for the development of functional stories. They can also include stories for bug fixes or fine-tuning. User stories focus on explaining the requirement without delving into the solution. They provide a sufficient level of detail to be actionable, but not so much that they become unrealistic. Striking this balance can be challenging, but it is crucial for effective backlog management.

Sprint Planning and Execution

Sprint Planning and Task Breakdown

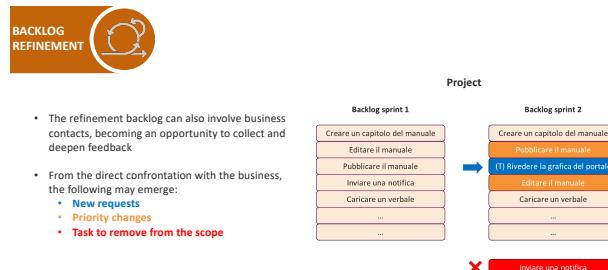
Sometimes, user stories lack sufficient detail to guide developers on what needs to be implemented. On the other hand, providing too much information can encroach on the team's responsibility to come up with the solution. The key is to strike a balance. During sprint planning, which typically lasts two to three weeks, the team selects items from the top and adds them to the sprint backlog. Each item is then discussed in detail. To better understand the complexity of a user story, developers can break it down into sub-tasks. Ideally, every team member can contribute to breaking down user stories into multiple tasks. However, this activity can be time-consuming, especially for larger projects with teams of around nine people. In such cases, sprint planning sessions can last up to two days.

Sprint Execution and Testing

The task explosion in sprint planning and execution can be a challenging process. It is not always straightforward and can vary in difficulty. One of the reasons for this is the lack of understanding of the tasks at hand. Sometimes, technical details are needed to fully comprehend how to implement them. Additionally, during sprint planning, there may be missing information that is necessary for task execution.

In traditional development, the process follows a sequential order: analyze, implement, and then test. However, with the agile methodology, such as the Scrum framework, the process is different. Here, you analyze, implement, and then test only a portion of the functionality. This approach serves as a contract between the product owner and the development team, defining the concept of "done."

Adapting and Improving



During the sprint planning phase, it is crucial to collaborate with your product owner to define the "definition of done" for the project. This definition typically includes criteria such as the software working in the integration environment, a functional demo during

the sprint review, and the development of unit tests. It is important to showcase the project's progress to the customer after each sprint to receive valuable feedback. Based on this feedback, you may need to make adjustments to the backlog, such as changing priorities, adding or removing items.

Another important meeting in the process is backlog refinement. This meeting allows for the discovery of missing or unnecessary functionality during implementation. Customer participation in the review often leads to the realization that certain requested features are not needed or were incorrect. During this meeting, you can add new requests, change priorities, and remove items from the project scope.

Sometimes, delays may occur, and instead of changing the deadline, it may be necessary to reduce the scope of the first release. By implementing the most important features first, you can still achieve your objectives. Less critical functionality can be removed and included in a second release.

Lastly, the retrospective is a crucial moment for reflection. Even if you are behind schedule, it is recommended to invest at least one hour after the sprint review to identify actions that can improve future performance.

Estimation and Velocity

Poker Card Estimation

For example, if you notice a lack of communication between the front-end application developers and the API developers, it may be beneficial to create separate rooms for each user story. This allows the people involved in that specific user story to work together, either physically or remotely, throughout the day. By doing this, you can improve communication and collaboration between team members. It's important to remember that each project is unique, so you may need to adapt your strategies to fit the specific needs of the project.

Now, let's recap what we've covered so far. If you have any questions or if you've used this process with your colleagues, feel free to ask. To start the project, you gather the requirements and create a product backlog. This can be done using a simple tool like an Excel file. The entire team is responsible for building and maintaining this artifact, while the product owner is accountable for its organization and explanation. The product backlog should be accessible to all team members.

Next, you organize the first sprint by conducting a sprint planning session with the entire team. During this session, you define the sprint backlog, which should

only include the most important tasks. To estimate the effort required for each task, you can use a technique called poker card estimation. Each team member has a set of cards with numbers from the Fibonacci series, which they use to estimate the complexity of each task.

Understanding Team Velocity

In order to estimate the complexity of user stories, each team member is given a deck of cards. The product owner explains the requirements of the user story and asks the team to assess the complexity. Each team member selects a card and places it face down on the table. The cards are then revealed simultaneously to see if the estimations are similar. The numbers on the cards correspond to the Fibonacci series and can indicate the number of days needed to implement the functionality or simply measure the complexity.

These estimations are then translated into a single unit of measure called function points. At the start of the project, one function point is equivalent to one day of work. However, this relationship can change throughout the project. As the team improves their skills and capabilities, the value of one function point may increase, such as becoming 2.5. This relationship is known as velocity.

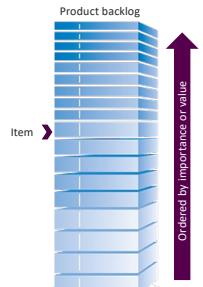
Velocity represents the team's speed and can be graphed over different iterations to track their improvement or any changes in their pace.

Practical Exercise

Setting Up a Product Backlog



- The Product Backlog is a list of items sorted on the basis of business value
- Items in the Product Backlog include features that go into realizing the Product Vision
- The highest, most valuable elements must be described in detail, so that the team can estimate and test them, and have a size that can be realized in the Sprint
- The list of stories evolves, changes and is updated continuously



Now, let's imagine that each team member expresses their estimation of complexity for a particular task. Since the estimations are quite similar, you associate this level of complexity to your story. Typically, you would choose the highest number as the estimation. So, let's discard the three and consider it as the complexity. For the first item in the backlog, we estimate that it will take three days based on our starting velocity.

However, during the poker card estimation, one team member puts an eight while others put a three. This

is a moment to start a discussion and understand why there is a difference. This is crucial because that person might have knowledge or insights that others don't. For example, they might know about a technical difficulty or a prerequisite for implementing the user story. After the discussion, we re-estimate using the poker card method. Usually, when the developer's explanation is reasonable, others adjust their estimations accordingly. In this case, we discover that the second item can be estimated with eight story points. Story points are another term for function points, but we use it because we are dealing with user stories.

It's important to note that the relationship between story points and the time needed to implement them can change throughout the project. This is why the poker card estimation technique is valuable. By asking for individual estimations, we prevent senior members from influencing the estimations of junior members. This is crucial because even junior members can bring value to the team. They might have previous project experience or knowledge that senior members don't have in this specific context. Everyone's input is valuable.

There are two special cards in the estimation process. One card indicates that the person cannot estimate because they lack knowledge or information. This is considered an infinite estimation. The other card, symbolized by a coffee cup, indicates that the person is requesting a break.

Now, let's review some rules. In the team, we have the product owner who owns the product and decides what needs to be implemented. The Scrum Master, on the other hand, is not a master of anything. They are usually considered a servant leader. They have a strong personality and excellent communication skills. Their main role is to ensure the methodology works smoothly. They organize the calendar for different meetings and their technical skills may not be the primary focus. Successful Scrum Masters can come from various backgrounds, such as philosophy, as long as they can effectively interact with people and create a comfortable project environment.

Now, let's put this into practice with a small exercise to simulate the creation of a product backlog.

Organizing the First Sprint

Let's begin by simulating the organization of the first sprint and creating a plan for it. Here is the project description:

The CEO, John Smith, wants to throw a fun and informal party for his employees, directors, and board members at his house. The main objective of the project is to ensure that the party is enjoyable. If the weather permits, the CEO would prefer to spend more

time in the garden than inside the house. A buffet is required to cater to approximately 100 people, and a barbecue is also desired. The CEO wants to have music during the event, so the band or a DJ needs to be hired. Additionally, before the party starts, there will be a 30-minute company meeting where the CEO will present the company's current status.

These are the requirements for the project. The idea is to divide yourselves into four or five teams. You can organize yourselves in the same way you are currently organized, for example, as teams one, two, three, four, and five.

Event Planning Exercise

You can access the team board that has been prepared for this exercise. The address is provided, and if you need it, I can also send it to you via email. The board contains the team conversation, and as the team lead, you are responsible for overseeing the process. You are also the product owner, meaning you can ask me for further explanations about the requirements.

To start, go to the top left of the board where you will find the empty product backlog. Your task is to write a small yellow post-it note for each item that you want to include in the backlog. These items should represent the characteristics of the stories, but keep in mind that this exercise does not involve implementing software. The objective is to achieve the goals set for the event planning exercise.

Organizing an event for 100 people may not be easy, especially if you have never done it before. However, you have the opportunity to prioritize the items on the backlog. If you need a better understanding of the priorities, you can ask me for further explanation as your product owner. Your job is to write down the tasks required to organize the event.

Now, let's divide into teams. Number one, you can start. Number three, you have decided to be number three. Let's continue with number two, then number six, and so on. This is a self-organizing team, so please begin. You have 10 to 15 minutes for this important task. If you need cards, you can use the ones provided. If you have any trouble accessing the board, let me know, and I will assist you. You can also refer to what your colleagues did last year for inspiration. If you need suggestions, feel free to ask. Some examples include checking weather forecasts, creating a backup plan for rain, setting a budget, cleaning the venue, arranging for food and drinks, selecting bedrooms, mapping accessible areas, planning for after-party cleanup, arranging for catering, hiring a DJ and bartender, renting equipment like projectors, tables, and chairs, sending out invitations, and organizing a wardrobe room.

Conclusion and Questions

As the product owner, I understand that you have many questions and requests regarding the project. Please feel free to ask me anything you need clarification on or any concerns you may have. I am here to assist you.

Agile - IV Lecture

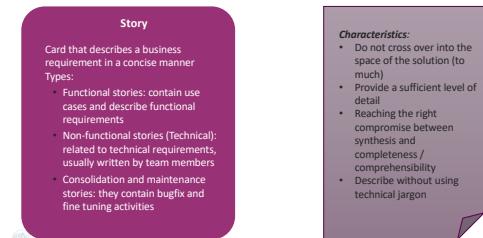
Agile and Scrum

Product Backlog and User Stories

So far, we have accomplished writing the product backlog. Now, let's focus on how to write a user story. This task can be challenging because it requires being concise and specific. A user story is more like a specification than a requirement. When writing a user story, it is important to be clear about what you want to achieve.

User story

The tasks that need to be done to reach the project objectives can be written as "User stories"



To ensure clarity, you can follow a practical approach. Start by writing the user story in the backlog. As you write, consider whether you will be able to understand the meaning of the story if you were to read it again in two months. If the answer is no, then the story needs to be rewritten in a more effective manner. On the other hand, if the answer is yes, then the story is likely well-written.

Writing Effective User Stories

Is a user story enough for a team? No, the implementation requires more than just the story itself. In Agile and Scrum, you can analyze and implement the user story in the same sprint. First, you select the user story and include it in the sprint. Then, you analyze it in detail to understand its complexity and estimation. However, a common challenge arises when the team fully understands the details of the user story, as this is when the actual complexity becomes apparent.

To address this, a pragmatic practice is to treat the analysis and implementation as separate streams, even if it deviates slightly from the theoretical perspective of the methodology. Instead of having two separate teams, think of them as two different streams.

Backlog Refinement and Sprint Planning

In the Agile and Scrum framework, the development team, product owner, and analysts work together to understand requirements and create detailed specifica-

tions. During the first sprint, the team can conduct an analysis sprint to produce an outcome that will be used by the developers in the second iteration. This detailed information will be available when planning the next sprint, ensuring that the stories for development in the second sprint are well-defined.

Practical Tips for User Stories

In the first sprint, the team works on user stories, while in the second sprint, they focus on detailed analysis and documentation for the next set of user stories. This creates a pipeline where analysis is done before development. Although this approach has some similarities to the waterfall model, it is acceptable in Agile projects. However, some Agile purists may argue that there are negative consequences to this way of working. Ideally, the analysis and implementation should be done in separate parts of the sprint. However, it can be challenging to organize this when there are people dedicated to analysis and others dedicated to implementation.

Sprint Execution and Analysis

If you haven't planned what will be included in the second sprint, it's likely that the team will start working on whatever is available. This can create a dependency or a pipeline similar to the waterfall approach. However, if you're concerned about introducing waterfall practices, you can mitigate this by keeping the length of your sprints short.

Challenges with User Stories and Estimations

Shorter sprints provide better control over projects because there is less to estimate and organize within a shorter timeframe. With fewer user stories, it is easier to estimate the work involved. Shorter sprints also allow for more agility and responsiveness. If any issues arise during the first week, adjustments can be made for the second sprint. However, there are some drawbacks to shorter sprints. The time spent on sprint planning, review, and retrospective leaves less time for actual implementation and development. For example, if a week-long sprint is considered, half a day is spent on planning, half a day on review, and some time on retrospective. This leaves only three and a half days for development. Despite the advantages of control, shorter sprints also come with additional overhead.

In the past, I worked with a team that struggled with estimation. We were unable to accurately estimate tasks, resulting in incomplete stories within the sprint. To address this issue, our Scrum Master decided to shorten the sprint duration. We experimented with one-week sprints, but even then, we made mistakes in

estimation. Eventually, we resorted to one-day iterations, with planning and review sessions held each day.

Sprint Review and Retrospective

The Scrum Master plays a crucial role in bringing rhythm to the project. While it is common to write user stories in a specific format, with the typical user and their desired functionality, it is not mandatory. Technical stories, for example, do not follow this format. The most important aspect of a user story is the acceptance criteria, which provide a clear description of what needs to be done. This creates a sense of comfort for the team, as they have a solid understanding of what is expected and can confidently declare a task as complete. It serves as a contract between the team and the product owner. By prioritizing and estimating tasks, the team can create a list of items to work on and track their progress.

The Role of the Scrum Master

In Agile and Scrum, the role of the Scrum Master is crucial in ensuring effective communication and time management. One of the key responsibilities of the Scrum Master is to facilitate the daily meeting, also known as the stand-up meeting. This meeting is designed to be short and focused, encouraging team members to provide concise updates on their progress.

To maintain efficiency, the Scrum Master may use a few techniques. One approach is to pass around a ball, allowing only one person to speak at a time. Another method is to conduct the meeting in a standing position, which helps keep the discussions brief and to the point. It's important for everyone to actively participate and use their three minutes to provide the necessary information.

During the daily meeting, the Scrum Master plays a vital role in preventing discussions from becoming too detailed or time-consuming. If team members need to exchange detailed information, the Scrum Master may suggest that they meet separately, ensuring that they don't waste the time of other team members. The Scrum Master is responsible for timekeeping and ensuring that all events are time-boxed, meaning they have a set duration.

Unlike the traditional waterfall model, where the project plan is fixed, Agile and Scrum embrace change. This means that the roadmap, which outlines the project's direction, can evolve with each sprint. Unlike traditional project management methods, Agile allows for flexibility and adaptation.

To visualize the project plan, a Gantt diagram can be used. However, it's important to note that in Agile, the

roadmap is not set in stone. Changes and adjustments are expected as the project progresses.

By embracing Agile and Scrum, teams can foster effective communication, adapt to changes, and ensure that projects are delivered successfully. The Scrum Master plays a crucial role in facilitating these processes and keeping the team focused and efficient.

Agile Project Management and Business

One of the responsibilities of the Scrum Master is to provide business updates on the progress of the project. Contrary to the belief that Agile projects are disorganized compared to Waterfall projects, Agile actually promotes clear organization and transparency. By clearly defining the work to be done in each iteration, such as completing three user stories estimated to take three days each, the Scrum Master can create a sprint burndown chart. This chart shows the progress of the project by indicating how many stories have been completed and how much effort has been expended on each item. It also shows the remaining work. The ideal trend is for the remaining work to decrease over time.

The chart can be created at the sprint level or at the project level, although the example provided is at the project level. It represents multiple sprints. By analyzing the chart, you can gather valuable information about the project's health. For instance, if the remaining work is consistently below the estimation, the project is in good health. However, if the remaining work starts to exceed the estimation, it indicates a potential delay. The chart also highlights significant events, such as when the team closed some stories or made remarkable progress on a Monday, resulting in a recovery of the project's timeline.

Another line on the chart represents the scope of the project, which is the sum of the estimated items in the project backlog. Initially, the starting backlog is written, but as the project progresses, it is common to realize that additional work is needed. This leads to an increase in the scope. However, the goal is for the scope to stabilize and eventually decrease as the project nears completion. This fluctuation in the scope is a normal occurrence in projects.

Overall, the sprint burndown chart provides valuable insights into the progress and health of the project, allowing the Scrum Master to effectively communicate this information to the business stakeholders.

Technical Debt and Its Impact

In Agile and Scrum, it is crucial to analyze why the team is unable to deliver value consistently. This is not an empty project; it requires a thorough examination

tion with the Scrum Master and the team to understand the underlying issues. One common problem is the team's inability to complete user stories. Unlike traditional waterfall projects, Agile methodologies allow for early detection of project deviations. After a few iterations, you can assess the project's progress, evaluate the team's capacity and skills, and determine if additional resources are needed to increase velocity. Techniques like pair programming can be employed to transfer knowledge and support less experienced team members. By using diagrams, you can communicate with the business and request additional resources if necessary. However, in Agile, the deadline remains fixed, so if the project is falling behind schedule, it is important to discuss with the customer and consider reducing the scope to meet the initial deadline. This example highlights the importance of closing tasks iteration after iteration.

Technical Debt Types and Trade-offs

Sometimes, people fail to log their work properly, resulting in the closure of everything in one day. This behavior can be avoided by consistently using the tools to log work. In Agile and Scrum, if a team is unable to complete a story within a sprint, even if they have completed 90% of it, the story is considered not yet started. The team can gain more time to complete it in the next iteration. However, this practice should be used cautiously, as it may indicate underlying issues that need to be addressed in the second iteration.

If new requirements arise during a sprint, they are added to the product backlog without changing the scope of the current sprint. This protects the team from disruptions during the sprint. It is not allowed for someone to approach the team and ask them to work on the new requirement instead of the planned work. This practice, known as waterfall management, can create problems within the team. However, if an unexpected event occurs during the sprint that requires a change in plans, the team can decide together how to handle it. For example, if a tornado is expected to hit the house of the Chief Officer on the day of an event, the team may need to rearrange their plans and organize something indoors instead of outdoors. This is considered an external disruptive event, and it can affect the project burn down chart. The green line in the burn down chart represents the ideal progress of the project.

During the project, you can use Instagram as a tool to provide updates on the progress of the tasks. The final meeting in the project is the retrospective, where you reflect on the project as a whole.

Let's consider an example to understand the process better. Imagine you are creating a roadmap for your project. Once you have prepared your backlog, you can

proceed with the sprint planning. During this planning session, you collaborate with your team to determine which stories will be included in the sprint.

After the planning, you move on to the sprint itself. At the end of the sprint, you conduct a review where each task is demonstrated to the product owner. This demonstration can take place in an integration environment or directly on your laptop. The product owner then evaluates and accepts or rejects the implementation.

If you have any questions about the methodology, feel free to ask. Implementing Scrum can be challenging for a team that has never used it before. It took my company at least 5 years of projects to become proficient in its use. Sometimes, certain aspects of the methodology may be overlooked or not followed strictly. For example, one major obstacle for someone accustomed to the waterfall approach is the need for a cultural change. This change affects the entire organization.

Developers often appreciate the Scrum approach because it allows for better process management and creates a more transparent environment. In a Scrum team, the product manager does not need to review the code of other team members, as the product owner is responsible for the development. This dynamic is not possible in a traditional waterfall approach.

In Scrum, every interaction within the team is regulated by the methodology. During the retrospective, every team member has the right to raise concerns and suggest improvements, regardless of their level of experience. This inclusivity allows for a more diverse range of perspectives and experiences to be shared.

In contrast, I have seen many projects where only senior members of the team were given a voice, excluding valuable input from junior members or those who joined the company from other organizations. This is a significant advantage of the Scrum methodology.

Another advantage is at the contractual level, although it requires a cultural shift. Let me provide an example. Imagine you are the CFO of a company and you need to sign a contract for a project. Typically, the projects I work on range from 1 to 5 million euros. In a traditional approach, you would create a contract with a fixed scope, timeline, and budget. However, this poses a significant risk for both the signing company and the implementing company. How can you accurately estimate everything without any prior knowledge? It is common for projects to experience delays and require additional time and budget.

On the other hand, when you buy a car, you expect to know the exact price, not just an estimate. Why is it not possible to have the same certainty for a 5 million euros project? The reason is that producing a car

is an industrial process with thousands of units being manufactured. However, the project you are working on is more like an artisanal activity, where each project is unique.

If you were to ask an artisan how much a chair would cost, they might give you an estimate based on their experience. However, if they have never built a chair before, their estimate could be significantly off, resulting in cost overruns. Many companies have faced bankruptcy because they relied on the best estimates provided by the waterfall methodology.

In contrast, an agile approach allows for a more realistic estimation. You can say, “Based on my analysis, my best estimate is this, but there is a margin of error. It could be 5% over or 1.4% under the estimated price.” If you need a more accurate estimation, we can work together on two iterations of analysis. I will thoroughly analyze everything and create a prototype that may even become part of the final product.

After two iterations, I can provide you with a detailed backlog. The output of the first iteration is the backlog itself, which allows for better estimation. If you need more precise estimation, we can do one more iteration. If you are satisfied with my work, we can continue working together. If not, I can provide you with a ready backlog that you can give to another company to continue from there. The fact that each iteration produces a potentially shippable product immediately adds value to the company. This makes it easier to sign agile contracts, even if it means providing a cost estimate and deadline. Trying to create a perfect diagram for a two-year project is unrealistic and often leads to overestimation. By working collaboratively and focusing on the most important aspects of the project, you can be more flexible and avoid signing unnecessary contracts. This approach reduces risks for both the company and the team.

Regarding maintaining software in production, if a bug is found, it can be addressed within a 15-minute time frame. A good Scrum Master will ensure that team members stay focused during daily meetings and limit their discussions to three minutes each. This helps synchronize the team and avoid going into too much detail. Successful teams often have capable Scrum Masters who can identify and address underperforming team members. The Scrum Master’s role is not to produce code or analyze the domain but to facilitate the process and measure performance. They work closely with the product owner to ensure smooth collaboration. Agile methodologies were invented by Japanese developers based on lean principles. These methodologies have been proven to increase efficiency and reduce development time. Companies like SpaceX and Apple have embraced agile methodologies to stay competitive. Scrum Masters play a crucial role in removing middle management and fostering direct communication between team members and higher-level executives.

Agile methodologies are not just about transparency and clarity but also about making more money and being faster than competitors. It is important to distribute responsibility and involve the entire team in estimations, rather than relying solely on one person’s expertise. The objective of introducing agile methodologies is to provide an understanding of the concepts and encourage their implementation in future projects. This can be applied to projects within your career or collaborations with colleagues. The next topic is microservices.

Microservices

Questions on Development Background

In the context of organizations, agile projects are commonly used to develop complex business information systems. These systems are typically intricate applications that require careful technical design. So, I would like to ask again, how many of you have experience coding in any programming language?

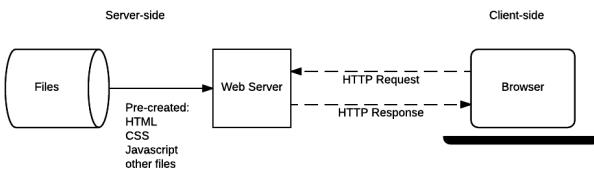
Let’s try again, shall we? In what programming language did you implement your web application? Ah, Java! A classic choice. Java has been around for quite some time now. So, tell me, what kind of application did you build? Was it a typical web application with a fancy user interface? Ah, I see. And on the client side, did you use React? No? Well, React is quite popular these days. It’s a JavaScript library for building user interfaces. Speaking of JavaScript, did you use JavaScript or TypeScript for your project? JavaScript, huh? I remember the days when writing JavaScript without the help of an IDE could be quite tricky. One missing semicolon and the whole code would break. Anyway, let’s move on.

Now, I want to talk to you about software architecture. I don’t expect you to become an expert in microservices architecture right away. It’s a vast topic. My goal is to help you understand the importance of software architecture. If you don’t implement things the right way, you can lose control over your project. Of course, if you’re building a simple MVC web application, it may not be a big issue. Let’s move on to the slides and dive deeper into the world of web development.

Static Websites

On the right side, there is a browser that sends HTTP protocol requests to our web servers. A web server is a software running on a server, listening on a specific port. It uses the HTTP protocol to exchange formatted strings with the browser. When a resource is requested,

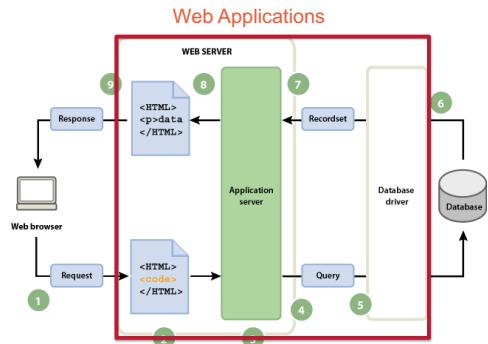
Static Web Sites



the web server searches for it in the file system and returns it as a text string to the browser. The browser then translates this text into a graphical representation.

This is an example of a static website, meaning it doesn't have any business logic implemented. However, static websites are still widely used today, especially for applications that generate static files as output. These static files can be served efficiently with high performance. For instance, news sites like Corriere.it are served by static web servers. Content delivery networks (CDNs) may also be used in conjunction with static applications. The main idea is to serve a static application.

Web Applications

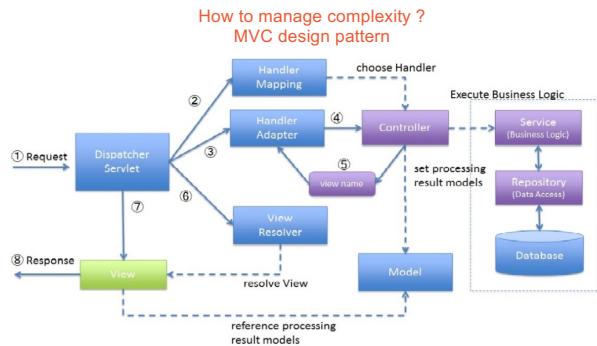


If you want to serve real-time information generated by your business logic, the architecture is slightly different. The browser sends the request to an application server instead of a web server. Inside the application server, you have the business logic that typically queries a database for information. The result of the query is then returned to the business logic, which transforms it into a presentation using HTML. HTML is a language that can be used on top of HTTP protocol to represent pages, and the page is rendered in the browser. In this case, instead of serving a static file, you are dynamically generating it.

To avoid having multiple people working on the same code with different objectives, it is better to create a more complex architecture with different components and assign specific responsibilities to each component. This is where design patterns come into play. Design patterns were invented to help create more complex architectures and allocate precise responsibilities to each

component.

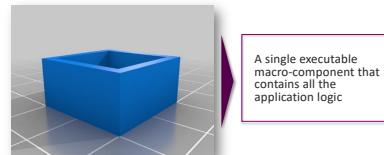
Monolithic vs Microservices Architecture



The Model-View-Controller (MVC) design pattern was initially developed for desktop applications but later adapted for web applications. In this pattern, when a request is made in a web application, it goes through a dispatcher component. The dispatcher determines the type of resource being requested (e.g., page, image, JavaScript file) and invokes the appropriate handler. The handler then calls the controller, which coordinates the execution of the business logic. The controller interacts with the dedicated business logic, retrieves data from the database, and creates a model. The model is then passed to a view resolver, which generates a view by combining the model's information with a template. The MVC pattern consists of three main actors: the model, the view, and the controller.

A simple example of the MVC pattern can be seen in frameworks like Tomcat, with implementations such as Spring MOC (Model-View-Controller). However, for more complex applications, a more intricate architecture is required. The complexity of the application determines the complexity of the architecture. If you attempt to implement a complex application using a simple approach or only relying on MVC in PHP, you may encounter limitations and code duplication. In such cases, you may need a common component that can be used across different parts of the application.

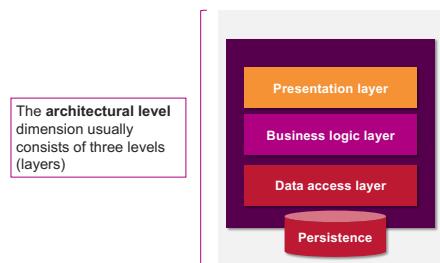
Monolithic architectural paradigm



In a monolithic architecture, the layers of presentation, persistence, and domain are all part of the same application. If a bug is introduced in one part of the application, the entire application fails to compile, and the pipeline cannot produce a new executable. While it is possible to organize business logic and presentation logic into layers and libraries, the monolithic architec-

ture has inherent limitations. These limitations will be discussed later. Essentially, a monolith refers to a single executable.

Architectural level



The monolithic architecture is a common approach in software development, where all components of an application are bundled together into a single executable. This includes the architectural layers such as the model, view, controller, presentation layer, and data layer. While this approach allows for easy development and higher initial productivity, it also comes with its drawbacks.

The weaknesses of monolithic architecture



One of the main challenges with a monolithic architecture is scalability. When scaling a monolith, you need to replicate the entire application, even if only a small part of it requires more resources. This can lead to inefficient resource usage. Additionally, if a new version of a component is not compatible with other parts of the monolith, upgrading becomes difficult.

Application maintenance

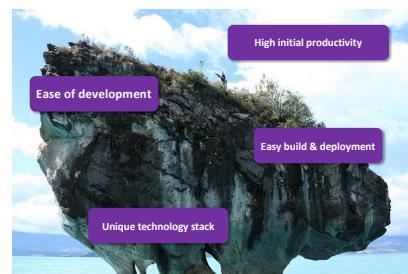


Another weakness of the monolithic architecture is the difficulty in maintenance and evolution. With a large codebase and tightly coupled components, making changes or adding new functionality can be complex and time-consuming. Technical debt, which refers to the accumulation of issues and shortcuts in the code, can also increase over time, making maintenance even more challenging.

Team scalability is another concern with monolithic architectures. As the team size grows, coordination and collaboration become more difficult. Adding more people to work on the monolith can lead to coordination problems and hinder productivity.

To address these weaknesses, many organizations are adopting a microservices architecture. In this approach, the application is divided into smaller, independent services that can be developed, deployed, and scaled individually. This allows for better scalability, as resources can be allocated specifically to the services that require them. It also enables easier maintenance and evolution, as changes can be made to individual services without affecting the entire application. Additionally, the team scalability is improved, as smaller teams can work on individual services independently.

The strengths of monolithic architecture



While the monolithic architecture has its advantages, such as higher initial productivity and ease of development, it is important to consider the long-term implications and potential challenges. Evaluating the specific needs of the project and considering the scalability, maintenance, and team collaboration requirements can help determine whether a monolithic or microservices architecture is the best fit.

Conclusion and Next Steps

In the next session, we will continue our discussion on microservice architecture and delve deeper into the topic. We will conclude our discussion on this subject in the first hour, and in the remaining hour, I will introduce you to some concepts related to development operations. Thank you for your attention, and I look forward to our next session.

Agile - V Lecture

Microservices Architecture

Alright, let's cover the final concepts before we wrap up the course.

Importance for Managers and Developers

In this section, we will discuss the importance of microservices architecture for both managers and developers. Even if you are a manager and not directly involved in development, understanding these concepts is crucial because you may be responsible for making decisions about the architecture based on factors such as budget and resources. We will also touch upon the relevance of DevOps and development pipelines, time permitting.

Microservices vs Monolith

Alternatively, you can rely on your technical team, who may recommend implementing a microservices architecture. However, if your business model is still evolving and your idea is not yet fully defined, a microservices architecture may not be the best choice. In this case, it might be more suitable to start with a quick and simple monolith architecture. Once your business becomes more stable, your requirements are well-defined, and your domain is established, you can transition from a monolith architecture to a microservices architecture.

Technical Debt and Team Dynamics

What is technical debt ?

«Technical debt is a term used in software development processes describing trade-off between choosing a quicker **short-term solution** that results in long-term consequences. Like financial debt, technical debt accumulates interest in the form of the **extra effort to overcome problems** that appear in the future»



Different forms:

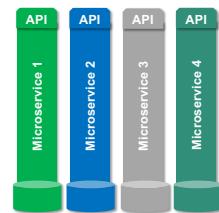
- Requirements: The gap between the captured product requirements and what was actually implemented.
- Versioning: Problems that arise with not using a clear versioning system or having a disorganized repository.
- Build: Problems with the building process that make it complex or difficult.
- Test: Any shortcuts taken in testing or a lack of tests.
- Defect: Any bugs or failures found in the software.
- Design: Technical shortcuts taken during the design stage.
- Architectural: Decisions made that compromise quality and maintainability.
- Documentation: Refers to documents on the project that are out-of-date, incomplete or a code base that lacks comments.
- Code: Refers to poorly written code that doesn't follow best coding practices.
- Infrastructure: Using tools, technologies or configuration that are not optimal for the software solution.

During our discussion on the weaknesses of the monolithic architecture, one crucial drawback stands out: the accumulation of technical debt. If you're unfamiliar with the term, technical debt refers to the consequences of having a complex application that becomes challenging to modify or adapt to market changes. Over time, even simple changes require significant effort. This issue typically arises after several years of development.

However, it's worth noting that if you have a highly skilled and stable development team working on a monolithic architecture, technical debt can be minimized. But as your team grows and new members are added to meet the need for speed and increased budget, the risk of accumulating technical debt becomes more likely.

Microservices Basics

- Application developed as:
 - suite of small executable units (microservices)
 - who publish business oriented API
- Philosophy : «**Do one thing and do it well**»



From a technical perspective, the answer to managing a larger and more complex application is to adopt a microservices architecture. The concept is straightforward: when faced with a large and difficult-to-manage application, the solution is to break it down into smaller, simpler units known as microservices.

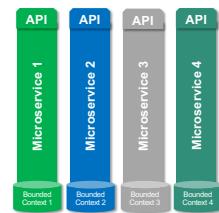
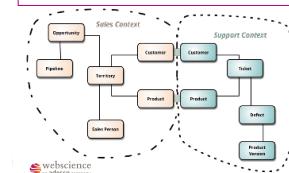
Granularity and Practical Examples

While the term “microservice” may seem ambiguous at first, there are no strict rules defining its size. Some argue that a microservice should expose an API for a single entity or table, but I believe that level of granularity is excessive. In my current project, the largest microservice I have consists of around 12 tables.

Microservices Philosophy

Logical architecture: bounded context

- Each microservice manages a consistent subset of functionalities (processes and entities) belonging to the global application domain.
- Each microservice manages a “**bounded context**”, a piece of the global domain that is sufficiently atomic and independent from the rest of the application domain

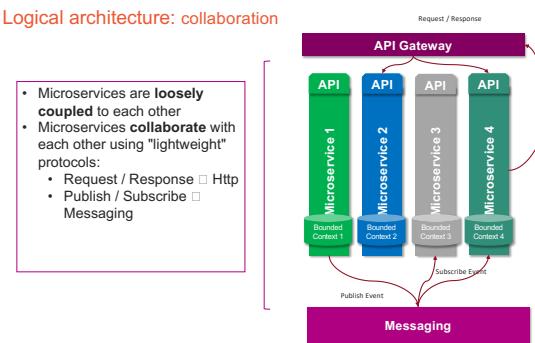


While my project consists of around 400 to 500 tables, having only 12 tables in relation to the entire domain model is relatively small. The philosophy behind microservices architecture is to focus on doing one thing and doing it well.

APIs and Inter-Service Communication

In the context of microservices architecture, each microservice can be viewed as an independent server-side application with its own database (if required) and an API. The API serves as the sole means of interacting with the business logic and data model within the microservice.

Data Duplication and Synchronization



There is another possibility that I will explain later, but it is crucial to avoid accessing or sharing databases between microservices. This is a common mistake that can lead to a complex and disadvantageous architecture. By coupling each microservice with a single data source, you end up with the drawbacks of both microservices and monolithic architectures. Instead, it is recommended to have different databases based on the specific domain and requirements of each microservice. For example, you can use a relational database or a NoSQL database, or even a search engine, depending on the needs of the microservice. Additionally, you have the flexibility to use different programming languages within the same application. This means that if you have a team where half is proficient in Java and the other half in Python, you can implement your application using both technologies. While this may not be the usual approach, it is feasible and can be beneficial for certain projects.

Now, let's address the concept of data duplication in microservices, which contradicts what you may have learned in database courses. In some cases, duplicating data across microservices is necessary. For instance, consider two microservices: one for sales and another for customer support. Both microservices require access to the customer and product tables. In this scenario, it is recommended to have separate instances of these tables in each microservice.

Event-Driven Architecture

In a microservices architecture, it is common to have one microservice designated as the model for changing and modifying entities, while the other microservices

only follow the master data and are not allowed to make changes. As a result, the microservices that do not modify the data typically only have the columns necessary for implementing their specific functionality. This means that the data is duplicated across multiple microservices.

To ensure that the duplicated data remains synchronized, you can use various methods such as a message bus, a queue system, or a distributed transactional log. These mechanisms facilitate the communication and coordination between microservices, allowing them to exchange information and keep their data consistent.

By designating one microservice as the master data source and making the others read-only, conflicts can be avoided. However, there may be cases where multiple microservices need to write to the same entity. In such situations, it is crucial to ensure that they write to different columns to minimize the risk of conflicts.

Overall, synchronizing duplicated entities in a distributed data model requires careful consideration and the use of appropriate messaging and coordination mechanisms to maintain data consistency across microservices.

APIs for Internal and External Clients

Are you familiar with any open-source technologies? One example is Kafka. Another is RabbitMQ. These technologies are used in the context of microservices architecture, specifically for communication between microservices.

Let's consider a scenario where we have two microservices: microservice one and microservice two. Microservice one has its own table, called table one, with an entity called T. When someone creates a new record for this entity through the API, it is stored in the database. After the record is created, we need to inform other microservices about this event, even if we don't know if they are interested. To achieve this, we use a message bus.

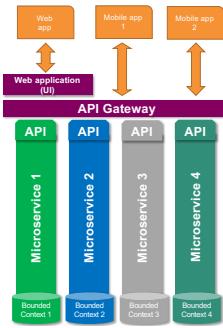
We publish the creation event, indicating that a new record has been created. Microservice two, which also has its own version of the entity, subscribes to this event. Whenever the event is published on the bus, the bus notifies the subscribers, sending them the details of the newly created record. Microservice two can then update or insert the new record in its own model.

This pattern of communication is known as publish and subscribe. Subscribers first subscribe to specific events, and then publishers publish those events. This is how microservices can interact with each other using events.

Another way for microservices to communicate is

Logical architecture: multichannel

- The focus on the development of business oriented APIs enables the **reuse** of microservices in different application contexts
- The development of different **multichannel** applications is simplified



through APIs. APIs are not only exposed to external clients, such as mobile or web applications, but can also be used for communication between microservices themselves.

Strengths of Microservices

The strengths of microservices architecture



Microservices architecture offers several strengths compared to other paradigms. One of the key strengths is its reliability. In a microservices architecture, even if a service is temporarily unavailable, events are saved on a message bus and will eventually be delivered. This ensures that messages are not lost and the system remains robust.

Another strength of microservices architecture is its flexibility and scalability. Unlike a monolithic architecture, where all modules write and read from the same database table, microservices allow for independent deployment and scaling of individual services. This means that each service can be developed, deployed, and scaled independently, providing greater flexibility and agility.

Additionally, microservices architecture enables better fault isolation. Since each microservice is a separate entity, failures in one service do not impact the entire system. This allows for easier troubleshooting and maintenance, as issues can be isolated and resolved without affecting the entire application.

From an architectural perspective, microservices architecture also promotes the use of APIs. APIs serve as the primary means of interacting with the business logic within each microservice. APIs can be implemented using REST, which is a simple and widely used

protocol for sending and receiving JSON strings. This allows for easy integration with various client applications, such as mobile apps or web applications.

In terms of application development, microservices architecture supports the implementation of different client applications, such as mobile apps or web applications. These applications can consume the same API provided by the microservice, eliminating the need for duplicating functionality. This promotes code reuse and reduces development effort.

Overall, the strengths of microservices architecture lie in its reliability, flexibility, scalability, fault isolation, and support for API-driven development. These strengths make it a powerful and popular choice for building modern, distributed systems.

Autonomy and Evolution

In addition to exploring the strengths of microservices applications, it is important to acknowledge their weaknesses. While microservices offer significant advantages, there are also drawbacks that need to be considered. One of the key strengths of microservices is autonomy, where the business logic and data model are combined.

Scalability and Team Structure

One of the key factors contributing to their success is their approach to architecture. In the past, architectures like web services with components such as enterprise service bus and business process server failed because they separated the business logic from the data model. This resulted in the business logic being represented as XML, trying to orchestrate calls between different applications through a business process server, while the enterprise service bus attempted to facilitate communication between endpoints. However, this approach led to a distributed data model and a disconnect between the business logic and the data model.

To ensure the success of microservices, it is crucial to keep the business logic as close as possible to the data model. The business logic and the API should be treated as atomic entities. The API serves as the contract through which functionality is exposed, while the implementation details are hidden. By exposing only minimal implementation details, you have the flexibility to make changes to the implementation without affecting the API. This encapsulation of implementation details allows for independent evolution of microservices.

Another advantage of microservices is the ease of problem determination. In a monolithic architecture with millions of lines of code, it can be challenging to

identify the source of a malfunction. However, with microservices, each microservice has its own log file, and there are tools available to collect and search through these log files. This makes troubleshooting and debugging much more manageable.

Scalability is another strength of microservices. For example, during peak seasons like Christmas, when there is a high demand for a product, microservices can be deployed on the cloud to handle the increased workload. This scalability ensures that the system can handle the surge in traffic without compromising performance.

Cloud Readiness and Hybrid Solutions

Let's consider the example of the catalog microservice, the order microservice, and the user customer. The catalog microservice is the most impacted by user navigation on your website. Normally, you may have one or two instances of this microservice in the cloud throughout the year. However, during the Christmas period, you may need to scale up and have multiple instances of the catalog microservice. On the other hand, the order microservice is fine with just three instances. This selective scaling allows you to address the scalability issue by only scaling the specific functionality that requires it. In contrast, with a monolithic architecture, you would need to scale the entire monolith, resulting in higher costs for expensive virtual machines on platforms like Amazon Web Services.

Another significant advantage of microservices is the ability to divide development efforts among multiple teams. In the project I am currently working on, we have a team of 40 people. It would be impossible for all 40 people to work on the same monolithic application. Instead, we divide the team into four smaller teams, each consisting of 10 developers, two front-end developers, and one database specialist. The database specialist rotates among the teams, so each team does not have a dedicated specialist. Each team takes ownership of a specific microservice, treating it as an internal product. This distribution of people and their attachment to different microservices allows for scalability. However, it can also create challenges if the individuals assigned to a particular microservice are unavailable. To avoid dependency on specific developers, it is advisable to rotate team members and not assign exclusive ownership of a microservice. Nevertheless, in situations where speed is crucial within a short timeframe, temporary ownership can be a viable solution.

For example, Spotify was developed by a collection of tribes, each consisting of nine people. The application is composed of different microservices, with each microservice managed by a different tribe. Each microservice is treated as a separate product internally.

The catalog, suggestion engine, and billing engine are examples of components managed by different tribes and teams. This approach allowed Spotify to build its platform in a relatively short period.

Another advantage of microservices is their readiness for cloud environments. In large companies, hybrid solutions are often used, combining resources from private clouds and internal servers. Microservices, with their use of networking protocols for communication, are well-suited for such hybrid cloud setups.

Drawbacks and Considerations

In a microservices architecture, it is common to have a combination of on-premise servers and cloud providers. This allows for flexibility and scalability, as you can scale specific microservices on the cloud during peak periods, such as Christmas, to ensure a smooth user experience. This level of scalability is not possible with a monolith running on on-premise servers. The advantages of this approach are evident, but it's important to consider potential drawbacks and points of attention, such as increased complexity.

Distributed Transactions and Saga Pattern

In a microservices architecture, it's important to consider the specific needs and complexity of your application. If you have a simple startup with a straightforward idea, it may be more beneficial to start with a simple monolith architecture rather than investing heavily in technology. This allows you to focus on developing functionalities without the added complexity of microservices.

However, if you have a Formula One team and need to compete in the championship, a microservices architecture is necessary. It requires a skilled team to manage the dynamic nature of bounded contexts. It's common for the requirements and domain of a microservice to change during the project, resulting in the need to move entities between microservices. This can be a costly process as it requires deep code refactoring.

One important consideration in microservices architecture is managing transactions. In a monolith, transactions are straightforward as they operate within a single database. You can start a transaction, perform multiple operations, and commit the changes to the database. If something goes wrong, you can roll back the transaction, ensuring that no changes are persisted.

However, in microservices, managing transactions becomes more complex. If a transaction involves entities from multiple microservices, ensuring that all changes are either written or none are written becomes challenging. The distributed nature of microservices

means that you can't rely on a single database to manage transactions across services. This requires careful design and implementation to ensure data consistency and reliability.

To enable rollback functionality in a microservices architecture, the Saga Pattern can be utilized. This design pattern facilitates distributed transactions among microservices, ensuring that the database remains atomic, consistent, and durable. However, it is important to note that sagas cannot achieve isolation, which means that other microservices can observe the ongoing transaction while it is being orchestrated by an orchestrator using messaging.

In contrast, isolated transactions only reveal the transaction's results to the rest of the world once it has been committed. By default, databases allow others to see the work being performed, but it is generally preferred to display the transaction's outcome only after it has been committed. With the saga pattern, this level of isolation is not possible. Instead, sagas operate on an "everything or nothing" basis. If an error occurs during the execution of a transaction, the saga will initiate a rollback, triggering the rollback command in each microservice involved in the distributed transaction. This ensures that any work contributed by the microservices is deleted.

In summary, it is important to understand the concepts of "publish and subscribe," microservices, their strengths, and when to use them. Additionally, it is crucial to be aware of the challenges associated with distributed transactions.

DevOps and Development Pipelines

Introduction to DevOps

DevOps is a crucial aspect of modern software development. It focuses on collaboration and communication between development teams and operations teams to ensure efficient and reliable software delivery. The goal of DevOps is to automate processes, improve deployment frequency, and enhance the overall quality of software.

By adopting DevOps practices, organizations can achieve faster time-to-market, increased productivity, and improved customer satisfaction. DevOps emphasizes the use of automation tools, such as continuous integration and continuous deployment (CI/CD), to streamline the software development lifecycle.

In traditional software development, there is often a disconnect between development and operations teams, leading to delays, errors, and inefficiencies. DevOps aims to bridge this gap by fostering a culture of collaboration and shared responsibility. Development teams

work closely with operations teams to ensure that software is developed, tested, and deployed smoothly.

One of the key principles of DevOps is the concept of "infrastructure as code." This means that infrastructure, including servers, networks, and databases, is managed and provisioned through code, allowing for greater scalability, flexibility, and reproducibility.

Another important aspect of DevOps is continuous monitoring and feedback. By monitoring the performance and usage of software in real-time, teams can identify and address issues promptly, ensuring a seamless user experience.

In summary, DevOps is a transformative approach to software development that emphasizes collaboration, automation, and continuous improvement. By adopting DevOps practices, organizations can achieve faster, more reliable software delivery, and ultimately, better meet the needs of their customers.

Project Management and Agile Methodologies

Now, let's discuss the first direction, which focuses on project management and how to effectively organize a successful team. This is known as the project management axis.

In the realm of DevOps and development pipelines, it is highly recommended to adopt agile methodologies. One popular option is Scrum, but there are other agile principles that can be followed as well. Agile methodologies are particularly relevant for certain career paths, such as the Scrum Master role. While technical knowledge is not a requirement for this role, having a solid understanding of technology can be beneficial. Additionally, there are other important roles within agile teams, including the product owner. If you have a clear vision of how the product should be defined, you can take on the role of the product owner. The second aspect to consider is the technology axis.

DevOps Principles and Practices

In the realm of architectural paradigms, one option to consider is the microservice architecture. This approach is particularly suitable if you prioritize agility and speed. However, it's important to note that the monolith architecture can also be a viable choice. Regardless of the architecture you choose, implementing DevOps practices is crucial.

Now, let's delve into what DevOps actually means. It's a term that combines development and operations, and it has gained significant buzz in recent years.

Cultural Shift and Tooling

DEV vs OPS – «Wall of Confusion»



In the past, development and operations teams worked separately, with different priorities and objectives. The development team focused on innovation, speed, and flexibility, while the operations team prioritized reliability, security, and problem management. This created a divide between the two teams, both organizationally and in terms of their goals.

The development team worked efficiently, following agile practices and producing software at a fast pace. However, when it came to deploying the software in a production environment, they had to rely on the traditional operations team. This process involved opening a ticket and waiting for the operations team to handle it, which often took a long time. This delay meant that the software was not being utilized and valuable feedback was not being received.

The operations team had their own challenges, such as dealing with emergencies and interruptions. They also had a different way of working, requiring issues to be raised through an issue tracker. This created a barrier between the development and operations teams, causing delays and miscommunication.

To address these issues, the concept of DevOps emerged. DevOps aimed to break down the wall between development and operations by implementing new methodologies and tools. While it took 20 years for agile practices to become widely adopted, DevOps gained traction more quickly due to its focus on cultural change and the use of tools to facilitate the transition.

By embracing DevOps, organizations could bridge the gap between development and operations, enabling faster and more efficient software deployment. This cultural shift and tooling allowed for better collaboration, improved communication, and the ability to deliver software that met customer needs in a timely manner.

DevOps Lifecycle and Automation

The concept of DevOps is a combination of patterns aimed at enhancing collaboration between develop-

What is DevOps?

"A mix of patterns intended to improve collaboration between development and operations. DevOps addresses shared goals and incentives as well as shared processes and tools."

Michael Hüttermann
"DevOps for Developers"

"A movement of people who care about developing and operating reliable, secure, high performance systems at scale"

Jez Humble
"Continuous Delivery"



"DevOps (a clipped compound of "software Development" and "information technology Operations") is a term used to refer to a set of practices that emphasize the collaboration and communication of both software developers and information technology (IT) professionals while automating the process of software delivery and infrastructure changes.

It aims at establishing a culture and environment, where building, testing, and releasing software can happen rapidly, frequently, and more reliably"

Wikipedia

ment and operations. It involves viewing the entire software lifecycle management as a unified process, rather than separate development and operations processes. Another variation of DevOps is DevSecOps, which emphasizes the importance of integrating security into the process.



The goals of DevOps are to increase speed, improve reliability, and reduce costs. There are three key ways to implement DevOps. The first is to adopt a systems thinking approach, recognizing that the goal is not just to develop an application, but to ensure its successful use by clients or customers. The second way is to continuously improve the process by seeking feedback and monitoring performance. This allows for experimentation and the exploration of new ways to achieve better results.

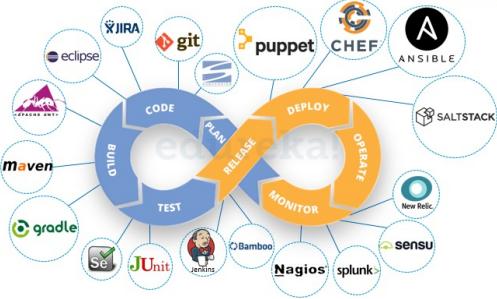
The symbol of DevOps is often represented by an infinity symbol, which signifies the different phases of the software lifecycle process.

Roles and Continuous Improvement

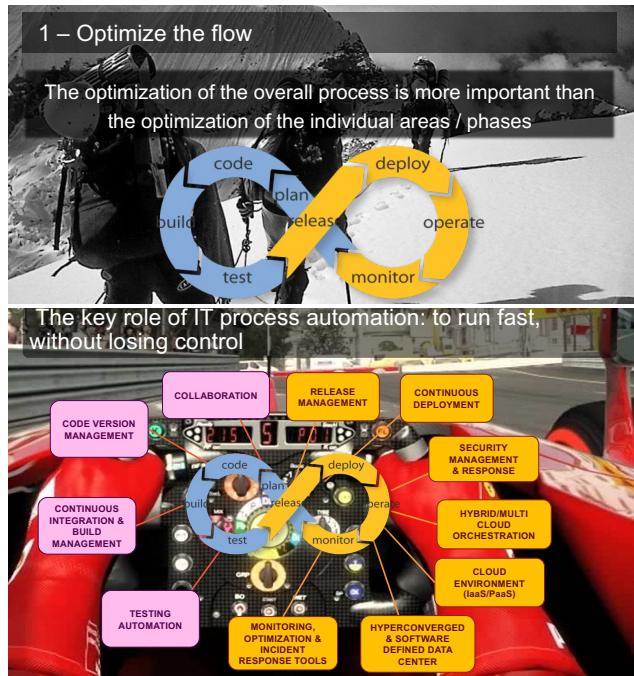
In the DevOps cycle, you start by collecting requirements and planning your iteration. Then you move on to coding and building the software. During this process, there are various steps, including unit testing, manual testing, and automatic user acceptance testing. Once the software is ready, it is released and stored in an archive with a version number. From there, it is deployed by other software. Customers and users then start using the software, and it is important to monitor it for any issues or resource constraints. The next step is to plan and code the next set of important features.

To implement DevOps, you can utilize a range of

DevOps Tools (example)



tools and technologies. For coding, you can use a code repository like Git, and development environments such as Eclipse, Visual Studio Code, or IntelliJ. To build the software, automation tools like Maven, Apache Ant, or Jenkins can be used. Testing can be automated using tools like JUnit. The orange and yellow sections represent the operations and development aspects, respectively. In the past, these were handled by separate teams, but now they are part of the same process. Operations teams can set up and implement toolchains to provide developers with self-service options for releasing and deploying software.



The main goal of DevOps is to automate as much manual work as possible in bringing software from a code repository to a production environment. The ability to push a single button and deploy a complex solution composed of multiple microservices is a significant achievement. Automation makes the process repeatable and allows for frequent production deployments. By optimizing the overall flow of the process, DevOps enables the management of complex distributed architectures. The focus is on optimizing the entire process rather than micro-optimizing individual areas like tests or code. In the DevOps approach, different roles are required to participate in the process, but now these

roles should be part of a single team rather than separate teams.

Final Thoughts and Summary

2 - Reduce waste by anticipating problems



Another important principle in DevOps is to address problems in the process as soon as they arise, rather than allowing them to progress to the next step. For example, if you are implementing a feature and you're unsure about a particular algorithm, it's better to solve the problem at that stage rather than relying on the unit test team to catch it later. By resolving issues at each step, you ensure that the subsequent steps receive good inputs and can produce the desired outputs.

While there are other roles that can be part of DevOps, they are not the focus here. The key is to promote continuous improvement. If you currently release to production once a month, consider aiming for a weekly release. In some projects, we even achieved daily production releases. This approach is more relaxing because if a mistake is made, it can be fixed the next day. It also allows for quicker response to customer feedback on new functionalities, rather than waiting for months to make corrections.



By increasing the frequency of releases and gaining experience in managing the entire software lifecycle, you become more efficient. This repetition and learning process is valuable. In summary, these principles of addressing problems early, promoting continuous improvement, and increasing release frequency contribute to a more efficient and effective DevOps approach. If you have any questions about these concepts, please feel free to ask.

Career Advice and Industry Insights

Software Quality and Enterprise Architecture

Agile methodologies are the future of project management. This is a crucial message. In the past, there was a misconception that software implementation could be outsourced to any team around the world because it was considered a simple commodity, like buying oil or electricity. However, big companies have come to realize that this approach was a mistake. By outsourcing software development, they lost control over their own technology and decision-making. The person working directly with the technology, who understands the problem and the domain, should be the one making important decisions. Smart companies have started to bring knowledge back in-house by hiring enterprise architects and building internal developer teams. They may still work with external software providers and system integrators, but they also ensure that their own developers are involved in every project to learn and transfer knowledge. The quality of software is paramount because high-quality software allows for faster implementation of new functionalities at a lower cost. On the other hand, quick and dirty solutions lead to technical debt and eventually hit a wall of sustainability. When this happens, it becomes more expensive to re-implement everything rather than making changes to existing software. Therefore, software quality is crucial, and it is important to have a clear understanding of the design patterns used at all levels, from individual components to the entire enterprise architecture.

Choosing the Right Project and Company Size

I have worked for companies that faced significant challenges due to poor data architecture and lack of enterprise-level planning. One particular company had 800 applications, each with its own database, and a complex network of scripts exchanging data between them. This resulted in spikes of CPU usage and a loss of control over the architecture. When they needed to add new functionality, they kept adding layers of complexity without considering the bigger picture. Eventually, they had to halt their business operations for several days, resulting in significant financial losses.

This experience taught me three important lessons. First, the architecture and software design are crucial. Without proper planning and oversight, a company can quickly lose control of its systems. Second, it's important to avoid being a "monkey developer" who relies on manual, repetitive steps for tasks like deployment. Taking the time to automate these processes can save time and effort in the long run. Lastly, when choosing a project or company to work for, it's important to consider the size and complexity of the organiza-

tion. While big companies offer stability and resources, smaller companies may provide more opportunities for growth and a closer-knit team environment.

I've seen colleagues and young entrepreneurs who either overcomplicated their architectures or created overly simplistic solutions. Both approaches can lead to technical debt and hinder future development. It's important to strike a balance and be adaptable to changing needs. While there is no set formula for when to switch to a microservice architecture, it's crucial to recognize when the current system is becoming too complex to handle future requirements.

In some cases, a temporary shift to a command-and-control management style can be effective for achieving short-term goals. However, this approach is not sustainable in the long run and may lead to team members leaving. It's important to create an environment that fosters collaboration and allows individuals to work in a way that suits their preferences.

In today's competitive job market, good developers are highly sought after. Recruiters constantly reach out with enticing opportunities, making it challenging to choose the right path. While working for a big company may offer stability and benefits, some individuals prefer a smaller, more intimate work environment where they feel valued and part of a close-knit team. Ultimately, it's important to weigh the pros and cons and choose a path that aligns with your goals and values. Starting with a smaller company can provide valuable experiences and exposure to a wider range of tasks and responsibilities.

When starting your career in a large company, it's common to be assigned to a specific role within a narrow sector. As a junior developer, you may find yourself working on the same task for many years. This is because larger companies tend to have more specialized roles and may not immediately place you in a higher-level position like an architect. If you want to gain exposure to different aspects of a project, it may be beneficial to start your career in a smaller company. Once you have gained more experience, you can then transition to a larger company.

For example, in my own experience, I worked for a company with 150 employees.

In 2000, the company was founded, and I joined in 2003. I am still working there to this day. In January of last year, we made a strategic decision to focus on software quality in order to compete in the market. Our approach was to offer higher quality software, even if it meant being more expensive. As a result of our success, we were acquired by a German company called Adesso. They recognized the value of our quality-focused mindset and are now using us as their first Italian company to enter the Italian market. I hope this explanation has been helpful in understanding our journey.