Data Visualization and Visual Data Analytics in ITSM

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Summary

Nowadays, the power of data analytics in general and visual data analytics, in particular, have been proven to be an important area that would help development in any domain. Many well-known IT services best practices have touched on the importance of data analytics and visualization and what it can offer to information technology service management. Yet, little research exists that summarises what is already there and what can be done to utilise further the power of data analytics and visualization in this domain. This paper is divided into two main parts. First, a number of IT service management tools have been summarised with a focus on the data analytics and visualization features in each of them. Second, interviews with five senior IT managers have been conducted to further understand the usage of these features in their organisations and the barriers to fully benefit from them. It was found that the main barriers include a lack of good understanding of some visualization design principles, poor data quality, and limited application of the technology and shortage in data analytics and visualization expertise.

Keywords:

Data Analytics, Data Visualization, ITSM, Business Intelligence.

1. Introduction

Data now dominate the modern business world, which is why scholarly attention has been directed toward gathering, analysing, visualising, and managing data differently. However, with large volumes of data coming in fast, users tend to be overloaded with tech-speak and jargon. As Andrienko and Andrienko explain, data visualization is about painting a picture of the data [1]. This often involves showing or displaying data in a picture or visual format, making it easier for human users to understand and use. The graphical or pictorial presentation of data, for example, using lists, maps, charts, and comprehensive dashboards ensures that what the data says has been communicated clearly and simply. The trends patterns in the data that would otherwise be difficult or impossible to see are made easy using data visualization.

As Keim et al. argue, visual analytics does the 'heavy lifting' as far as big data is concerned [2]. This is achieved using various processes, including machine learning, algorithms, and natural language processing. Nowadays, the power of data analytics in general and visual data analytics, in particular, have been proven to be an important area that would help development in any domain. Many well-known IT services best practices, such as ITIL (Information Technology Infrastructure Library), have touched on the importance of data analytics and what it can offer to ITSM. Yet, little research exists that summarises what is already there and what can be done to utilise further the power of data analytics, and data visualization in particular, in this domain.

2. Background

2.1 Overview of ITSM

Information Technology Service Management (ITSM) is the process of planning, monitoring, and controlling the service delivery of information technology (IT) [3]. ITSM has become an increasingly important aspect of information management as it offers a means to achieve business goals, improve operational efficiency, and protect information assets. In this literature review, we looked at the different frameworks and models for ITSM, as well as the effectiveness of each. Other areas explored in this research include the benefits of implementing ITSM in organisations, some of the tools utilized, their characteristics and the integration of data visualization.

ITSM is a rapidly growing field that has a significant impact on organisations. It is the practice of managing IT services to meet the needs of an organisation. ITSM is often seen as the bridge that connects information technology (IT) management with business management [4]. Data visualization is a crucial tool in ITSM and is beneficial in various ways, including improving problem-solving, decision-making, and knowledge management.

Information technology service management field is a field that has seen remarkable growth in recent years. This is partly due to the rapidly changing technologies that businesses rely on and the need for efficient and effective delivery of these technologies. To help manage this growth, selecting the proper framework for a business and team is essential. There are many available models, but the most

common are the service management framework and the information technology service management model [5]. Both frameworks help managers understand the various aspects of the IT service delivery process and make informed decisions about the best technologies and practices. Additionally, periodic training programs are essential for employees involved in ITSM delivery. This ensures that everyone has up-to-date knowledge of the latest technologies and can deliver quality service.

ITSM helps integrate business processes with information technology operations. Studies show that its effectiveness depends on the organisation's commitment to implementing it correctly and consistently across all divisions or functions [6]. ITSM helps identify, diagnose, and solve problems quickly- leading to improved customer satisfaction ratings. It also provides a framework for integrating business processes with information technology operations and data visualization, improving overall organisational performance.

2.2 Data Analytics for ITSM

Azvine et al. argued that data analytics for predicting market trends was a critical business activity in the current competitive environment to ensure improved enterprise performance [7]. The authors, however, noted that to reap the fruits of data analytics in Information Technology Service Management (ITSM), businesses need to perform their data analysis in real-time and necessary data visualization reports generated in to guide actions to be taken in real-time to meet the rapidly changing customer demands or even regulations.

Business Intelligence could be described as using different applications and technologies to gather, analyse, and generate information based on visual data presentations presented by reports to make better business decisions in ITSM [8]. Data visualization and visual data analytics provide actionable insights important to ITSM. According to the researchers, advanced business analytics tools such as HP Openview Decision Center include data mining and predictive analysis using Web services and advanced visualization based on rule-based simulations, driving productivity further in ITSM.

According to Saggi and Jain, big data analytics is becoming a trending practice in the ITSM decision-making sector due to the enormous amounts of data such companies generate [9]. Recent developments in Big Data analytics provided a new solution for collecting, storing, and advancing analytical data visualization for more informed business insights for ITSM.

2.3 Integration of Tools and Data Visualization

The framework for designing an effective ITSM process involves monitoring and evaluating the ITSM process regularly to identify any changes or improvements that need to be made. Next, an organisation's business goals and objectives should be identified so that the ITSM process is tailored to meet those needs. Third, the ITSM process design should balance the needs of the organisation and its IT department. ITSM processes should be repeatable and standardised to identify and fix problems easily. Finally, an action plan to address identified risks/threats and opportunities should be developed and implemented [10].

ITSM manages and monitors hardware, networks, applications, service levels, and incidents. Some of the most commonly used tools in ITSM include incident tracking tool (IT), performance analysis software (PASW), database management system (DBMS) for service level reporting and trending, systems administration tools (SSAT), resource management system/application portfolio manager (RMSPAM/APMM), enterprise resource planning suite (ERP)/supplier relationship management (SRM) systems and others [11].

The purpose of data visualization could be exploratory or explanatory analysis. As the names suggest, exploratory visualization helps gaining new insights by exploring the data visualization, while explanatory visualization enables communicating insights with other audiences using the data visualization. Both aspects, explanatory and exploratory data visualization, could be integrated into ITSM to help enhance the delivery of services. For example, data visualization can be used for trend analysis, team collaboration, problem-solving and forecasting. In general, it can help to understand complex processes better through easy-to-use dashboards and displays, thus, helping to make better decisions. Furthermore, data visualizations are often used to measure performance and track changes over time. By monitoring KPIs (Key Performance Indications), organisations can better understand the health of their systems and make necessary changes.

Integrating data visualization in ITSM is a crucial way to help managers improve the efficiency and effectiveness of their ITSM program. Data visualization can help identify problem areas and make it easier for management to understand information related to its overall goals. Moreover, by using data visualization tool, IT managers can see how their focus areas are related to the company's overall goals. This allows them to connect the dots better and see how their work relates to the bigger picture. Ultimately, this can help to improve the organisation's overall ITSM operation.

2.4 Business Intelligence drawn from data visualization for ITSM

Negash and Grey described business intelligence as the data collection, storage, and analysis of this data to draw actionable knowledge and information to be used in decision-making in ITSM business processes [12]. This study article highlighted that using business intelligence for ITSM offers them competitive intelligence, especially against their competitors, Analysis of business intelligence data is vital in these firms' reporting, real-time service management as well as responding to ad hoc queries. Multiple vendors have developed business intelligence applications with dashboards that display business performance monitoring and activities monitoring. Its wide mass adoption by staff in the companies makes it very effective in managing and implementing business processes. The study concluded by stating that business intelligence was essential in developing operational and organisational strategic performances and improving the organisation's business performance in ITSM.

Caseiro and Coelho investigated the impacts of business intelligence on the performance and innovativeness of manufacturing companies [13]. A study of 228 sample companies in Europe showed that systems that performed data visualization and visual data analytics in ITSM positively affected network learning and overall business performance. This study brings out the lack of resources as some of the significant challenges that face some of these companies but concluded by stating that as business intelligence is key in the strategic planning and decision-making of these companies, much effort must be put into the companies lagging as the financial payouts are immense.

The increasing popularity of business intelligence and analytics and its impact on ITSM companies' performance has made it an interesting field of research in the recent past [14]. In this study, the researchers proposed a model for assessing the impact of business analytics on the overall performance of business. Based on 204 sample data collected from medium to high manufacturing firms, the results were consistent with previous studies indicating that adopting business intelligence in these companies positively influenced business process performance. This study recommended the adoption of data visualization and visual data analytics in the strategy formulation of ITSM firms as it was an integral tool in the decision-making process of these firms and hence improved the output and growth of such companies.

In another study on the impacts of data visualization and visual data analytics, Falahat et al. examined the competitive edge acquired from implementing business intelligence strategies in ITSM [15]. According to the empirical results, manufacturing firms implementing ITSM has an advantage in international performance. Similarly, business intelligence in such companies is paramount in establishing and adopting marketing strategies, product innovation, product price setting, and in-market search and the search for the most effective communication strategy to reach their target consumers [15].

2.5 Impact of data analytics on strategic performance in ITSM companies

Data visualization and visual data analytics are emerging technological trends in Big Data analytics promising to improve management's strategic performance and the overall business performance in Information Technology Service Management (ITSM) [16]. In a study aimed to investigate the impacts of data analytics on business operations and strategy implementations in the ITSM sector [16], the researchers conducted an empirical study of three IT firms with different data analytics applications in their companies, either as beginner, medium, or heavy users. The study results showed that data analytics and visualization were resourceful in terms of data collection, access, and delivery, as well as in an analytical capacity. In combination with the organisation's implementation of data analytics strategies, the top management of these companies gained essential insights, and the returns could not be understated in financial performance as well as in the overall employee-customer engagement, which translated to enhanced business performance within the ITSM companies that deployed data analytics and visualization on a mass scale.

Another study evaluated the impacts of data visualization and visual data analytics in ITSM firms as multifaceted into data quality, the mass of data, analytical skills, domain understanding, and tool availability [17]. Empirical studies showed that there existed a significantly positive association between the use of data visualization and visual data analytics to firms' overall strategic performance [17]. These findings highlighted that all the facets of data analytics significantly improved the overall business performance of these companies. The researchers concluded by recommending the adoption of visual data analytics and data visualization in ITSM firm's strategy formulation, thus enhancing managerial decision-making performance in these firms.

Seyyedamiri and Tajrobehkar investigated the impact of data visualization and visual data analysis of marketing strategies on social media platforms on the success of ITSM companies [18]. A descriptive research method was adopted for the study. The findings showed that data visualization and visual data analysis on social content marketing

strategies substantially affected these companies' service delivery. The researchers emphasised that high-tech firms ought to consider the publication of content either through m- or e-commerce while using data analysis to point out and better understand the demands of their users, therefore, meeting customer expectations. This would improve marketing strategies, increase revenues, and the effectiveness of service management processes.

2.6 Data visualizations and visual data analytics for ITSM in sales

Roßmann et al. note that in the current world, the progressive growth in available data has led to the rise of numerous accelerated business intelligence applications known as Big Data Analytics [19]. The applications are of great value in Information Technology Service Management (ITSM) as they provide necessary tools for supporting informed decisions in this global and volatile dynamic customer service management network. Compared to conventional institutional methods, Roßmann et al. discovered that Big Data Analytics in customer service management was more advantageous in analysing the effect these factors would have on the predictions of customer satisfaction and retention [19]. The researchers conducted a Delphi survey to integrate expert assessment expectations for 2035 in ITSM. The study suggested that business decisions drawn from the visualization of data analytics would lead to an improvement in forecasting demands, a reduction in the reduction of safety stocks as well as ensuring timely deliveries of products [19]. The researchers highlighted that data visualization and visual data analytics in ITSM firms would lead to increased experience automation, replacing the traditional tasks that lead to late deliveries and poor customer experiences [19].

Seyedan and Mafakheri argued that data visualization and visual data analytics applications in ITSM for supply chains could help prevent late deliveries by suppliers due to their effectiveness in predicting customer orders and analysing trends from shipping days to predicting demand [20]. The various algorithms and their applications in Information Technology Service Management were classified into regression analysis, time-series forecasting, clustering, and support vector machines. The researcher also highlighted the lack of literature to support the prediction accuracy by the algorithms in reducing the number of consumer agonies resulting from late deliveries and the links with several factors such as order items and discounts, and order items quantity, among others, would lead to untimely deliveries [20].

3. Data Collection

This section is divided into two main parts: an evaluation of some of the known available ITSM tools and the visualization features in each of them, and interviews with IT managers.

By reviewing the ITSM tools, the current study specified the data analytics and visualization features embedded in each tool and the characteristics of these features. The interview with IT leaders investigated how data visualization would benefit from the ITSM tool they are using, which features they use, and the barriers preventing them from utilising all the available data visualization options.

3.1 ITSM Tools

Implementing, administering, and providing IT services is known as ITSM. It is used to enhance customer service in accordance with company objectives. In particular, infrastructure and operations (I&O) managers are given the tools they need by ITSM to support the production environment efficiently. ITSM technologies make managing and delivering quality IT services easier by facilitating tasks and procedures. Its service desks and service delivery operations extensively use these [21]. Among the ITSM tools are:

3.1.1 NinjaOne

NinjaOne is a cloud-based platform that offers managed service provider support specialists the tools they need to manage client site systems. The IT operations divisions of multi-site corporations can also utilise it. This system can be accessed from anywhere using any standard Web browser because it is cloud-based [22]. NinjaOne is a subscription-based project management solution that can communicate with other project management tools and Managed Service Provider (MSP) management systems, including task documentation services. The primary characteristics of this ITSM tool are team management service, auto-discovery and inventory creation, and system monitoring and management. NinjaOne allows building custom dashboards using various types of charts, graphs, and tables to visualize metrics such as SLAs (Service Level Agreements) and ticket status. Using such dashboard helps the team manager to know allocated and pending tasks assigned to his/her team, monitor key performance indicators (KPIs) and make data driven decisions. Most of the data visualization techniques used in NinjaOne are basic techniques such as, bar charts, line charts, and pie charts. Figure 1 shows a sample NinjaOne dashboard [23].

3.1.2 SuperOps

This ITSM application is ideal for small to medium-sized managed service providers, IT teams, and consultants. SuperOps's comprehensive ITSM platform is a natural combination of modern ticketing and easy asset management to provide outstanding IT services to clients. It has a varied, ever-expanding network of third-party integrations to increase platform capabilities and bring the tech stack closer together [24]. SuperOps has four plans: solo, geared at freelance technicians; Starter, which only provides Professional Services Automation (PSA) features; and the valuable plans, growth and premium, which include RMM and PSA services as the Service Desk module.

Among the primary visualization features are a ticketing system, cloud-based deployment, and team and task management [24]. The ticketing system is at the core of this service. The technology offers each technician a dashboard that allows them to manage their tasks. The team manager is also given a special dashboard from which to track developments and act to reassign tickets as necessary. This system can convert project plans into tasks, which can then be ticketed and deployed to technician team member. Project objective tracking is made easier by the Service Desk system's automated timesheet. If billing problems arise, the automatic activity description creates a proof library. Advanced visualization techniques such as heap maps, scatter plots and tree maps are used in SuperOps.

3.1.3 HaloITSM

HaloITSM is an ITIL-based ITSM solution that offers IT asset management and customer service management. Its comprehensive services include the management of incidents, problems, change, knowledge, configuration and an ITIL service catalogue [25]. This tool's main features include asset discovery, assistance with desk functions, and a user self-service portal [25]. The service offers team management features to track project staffing needs and monitor Program Desk personnel activity.

HaloITSM includes pre-built dashboards that provide users with real-time data on incidents, changes, and service requests. These dashboards offer visualization of KPIs such as the mean time to resolve (MTTR) and first response time (FRT). Various visualization techniques are used in these dashboards [26].

3.1.4 BMC Remedy ITSM

BMC Remedy is one of the ITSM tool that was created in accordance with ITIL principles [27]. With regards to data visualization and visual analytics features, it provides advanced reporting and dashboard solutions that visualize key IT service metrics such as service request volumes and
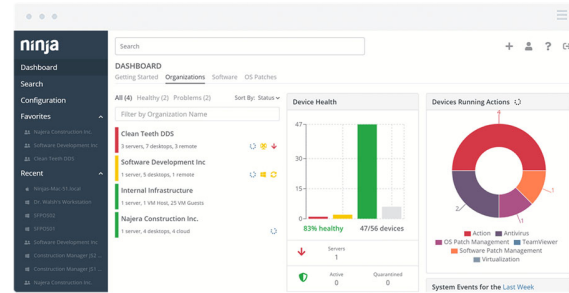

Fig. 1 NinjaOne sample dashboard [23]

SLA compliance. BMC Remedy also includes predictive analytics and machine learning features that could help in predicting potential service outages.

3.1.5 Jira Service Mangement

Jira Service Management from Attlassian is one of the widely known ITSM tools [28]. In addition to the ITSM features it shares with other ITSM tools, it provides flexible analytics and reporting features that enables IT managers to track IT service health and make data-driven decisions. Teams can also use dashboards to analyse trends and monitor service desk performance. Various visualization techniques are used in these dashboards including stacked and funnel charts and timelines.

3.2 Interviews with IT Managers

The sampling technique used here was purposive sampling, where the researcher's judgement and knowledge of the target population were used to select those who participated in the study. Five IT managers were targeted. Interviews with IT senior managers explored their knowledge about data and data visualization and its utilisation within their daily work to provide better IT services.

3.2.1 Interview Questions

The instrument used by the researcher in collecting data is semi-structured interviews, and the questions were:

> *1. Please tell me briefly what you understand by data visualization and its importance in the IT sector.*
> *2. What ITSM tool(s) are you currently using? How would data visualization help or benefit this tool?*
> *3. What are the barriers that prevent you from utilising all the available data visualization options?*

3.2.2 Analysis and Discussion

Table 1 below provides quotes from IT managers responses to the interview questions, what do they believe the significance of data visualization in ITSM, and the barriers they think are exist.

Table 1 Analysis and discussion of interviews with IT managers

Theme	Evidence from data	Analysis
Data Visualization and its importance in the IT sector	*"Data visualization, in my opinion, is a simplified yet crucial analysis approach that translates complex data into insight that can be understood quickly by people who are not statisticians or anyone. Data visualization and visual data analytics provide actionable insights important to ITSM, and this is because it plays a crucial role as far as reporting, real-time service management as well as responding to ad hoc queries is concerned. In my organisation, for example, data visualization is the fastest way to share business intelligence within departments and a quick way of passing critical business information..."* *" ...business intelligence in the modern business sector is everything. They say data is the new oil, and what this simply means is that if you cannot leverage the importance and availability of big data and analytics, you are unlikely to compete in the modern business environment...; think of data visualization as the magic screen that gives meaning to large volumes of textual and numerical, or even pictorial data. Visualization gives the visual impression that gives a quick overview of what a manager or any user is looking at."* *"...I'd say visualization is a very effective way of sidestepping the overwhelming volumes of data and statistical jargon, as well as tech-speak.."*	Consistent with Negash and Greys' findings [12], the respondents reiterated the importance of data visualization, especially in communicating the business intelligence necessary for developing operational and organisational strategic performances and improving the organisation's business performance in ITSM.
ITSM tools and how data visualization benefits the tool	*"...in my organisation, for example, the common ITSM tools we use are NinjaOne and SuperOps, and these tools make the whole process of data collection, access, and delivery as well as in an analytical capacity much easier, faster, and effective. In combination with our data analytics strategies, the management is in a prime position to gain important insights. This has reflected very well in our financial performance... we have also seen significant improvements in other outcomes such as overall employee-customer engagement which translated to enhance business performance..."*.	Agreed that data analytics facets significantly improved overall business performance. Data analytics and visualization are significant in the better formulation of marketing strategies.

Table 2 Analysis and discussion of interviews with IT managers

Theme	Evidence from data	Analysis
ITSM tools and how data visualization benefits the tool	*"in our organisation, Atera Helpdesk software and Jira are most common, but to incorporate even better data visualization features, Tableau is also a vital tool that we use. Frankly, however, I do not think many of us really know what goes on with these tools. We use them, but only to a very limited extent, and I believe perhaps we need to be trained further to appreciate their importance…"*	Some IT teams do not use any data analytics and visualization features although they have ITSM tools that have these capabilities. It was noticed that they use the tools mainly for sharing information among software development team but not for analysis nor improvement. Answers showed the limited knowledge of what the data analytics and visualization
Barriers to utilisation of available data visualization options	*"One of the major challenges we face when exploring data visualization options is that sometimes the data quality generated by the ITSM tool might not be very good. This is especially in terms of data format and the missing data…"* *"…one major challenge is the lack of expertise in data visualization and analytics. To use these tools, one has to have good knowledge not just in statistics, but also in the interpretation of visual analytics…"* *"…the main problem is not being able to understand visual representation of data…"* *"…However, I do not have a data analyst in my team due to the limited resources…."*	The main challenge facing the utilisation of available data visualization options include a lack of expertise in data visualization and analytics, poor data quality, and a general lack of understanding of data visualization and its application in ITSM. The limited resources make the decision of hiring an expert in data analytics and visualization not a priority.

5. Conclusion and Future Work

While all the IT managers interviewed showed an understanding and appreciation of data analytics and visualization, it was noticed that there is limited knowledge of what these features in the ITSM tools they are using could offer to them. While conducting the interview some of the managers pointed to the shortage in the data analytics and visualization expertise in their team due to the limited financial resources available to them. In other words, if they have a job vacancy, they would hire a programmer for software development rather than taking this position for a data analyst. Therefore, it is recommended to spread awareness of the role of a data visualization expert and what s/he could offer to this sector.

Some of the IT managers pointed to the quality of data generated by the ITSM tool they are using. Future work could look into ways to enhance data quality in ITSM tools and develop algorithms for this purpose. At the end, data analytics and visualization would not have a positive impact if the data quality is flawed.

Other IT managers thought that their team lack the knowledge to correctly interpret visual representations of data. As a result, they only use a few features in the ITSM tool although they invested and purchased the full package of this tool. It was noticed that some IT departments only use a tool like Jira or HaloITSM to only communicate during software development, and do not use any data analytics features in these tools. Arranging and providing good training in data analytics and visualization would enhance the whole team performance and enable them to reflect on their work and use the insights from visualizations for further development, as well as presenting their work to their managers and external parties.

To summarise, this study demonstrates that data visualization is critical for the modern business environment. However, even though there is much understanding of the possible benefits of data visualization, there is still limited understanding, especially in terms of how to use various modern tools in ITSM. Data visualization has played an essential role in drawing insights from large volumes of data and in other important outcomes such as financial performance and customer engagement. The main barriers to utilising available data visualization options include that many organisations cannot use visualization features because of a lack of good understanding of some visualization design principles, poor data quality, and limited application of the technology.

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