Linking Digital Orientation and Data-Driven Innovations: A SAP-LAP linkages framework and research propositions

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Abstract: Data-driven technologies can have a broad impact on innovation management, making them a particularly complex and debatable topic that requires refinement from a research perspective. Along this line, this study aims to understand how digital orientation facilitates the adoption of digital technologies to improve innovation performance. Using organisational learning theory and dynamic capability theory within Situation-Actor-Process (SAP) Learning-Action-Performance (LAP) framework, the study systematically captures and analyses the complexities and interactions among the factors affecting data-driven innovation in a case organisation, ABC, a prominent automaker in India, and proposes actions that can lead to improvement in innovation performance through the coordination between situation, actors and the processes involved. We have identified the factors driving digital orientation, namely competition, customer expectations, government regulations and environmental norms and developed an understanding of how digital orientation facilitate the adoption of digital technologies, which in turn produce data-driven insights and help in developing capabilities to improve innovation performance. The study also highlights contingent variables that influence the relationship between data-driven insights produced by digital technologies and innovation performance. This study extends digitalisation and innovation literature by developing propositions and offering a conceptual model, which practitioners can employ to develop digital orientation and enablers for facilitating technology adoption, and innovation performance.

Keywords: *Data-driven innovation, Digital orientation, Digital technologies, Dynamic Capability, Organisational Learning*

1. Introduction

Modern digital technologies such as internet of things (IoT), cloud computing, robotics, artificial intelligence, cyber-physical systems (CPs) have disrupted the conventional ways of doing business and have accelerated the pace of data-driven innovations (Florez Ramos and Blind, 2020; Akter et al., 2019, Lyytinen *et al.*, 2016). Data-driven innovation refers to an innovation process that relies on digital technologies to offer new products, services, or processes(Babu *et al.*, 2021). CPs and IoT connect all physical devices with the internet, where CPs bring their unique benefits such as computing, precision, control, coordination, autonomy, and communications. Apart from it, IoT and CPs are converging into the internet of services, which applies cloud technologies to facilitate sharing of data within and between firms, bring agility and flexibility and minimise cost. Data-driven capabilities also help in improving firms' performance (Akter et al., 2016). Big data analytics is employed for scaling and evolving information technology to facilitate faster access to a large volume of data (Kumar et al., 2021). Digital technologies, like big data, cloud computing, internet of things and, more generally, all the technological developments, allow the acquisition, analysis, and dissemination of various data and become an integral part of innovation management(Wroblewski, 2018). Moreover, novel digital technologies shorten the life cycle of existing products, thereby driving firms to accelerate the pace of innovation (Mubarak and Petraite, 2020a).

Despite the acknowledged benefits and growing attention of digital technologies, the comprehensive understanding of how organisations build and derive benefits from digital technologies is incomplete(Kindermann *et al.*, 2020). Studies reported that it is not only technology but organisations' strategic orientation towards digital technologies that help in building and promoting digital innovation and ultimately offer a competitive advantage (Khin and Ho, 2019; Mubarak and Petraite, 2020). Digital orientation provides strategic directions in formulating and implementing digitalisation strategies. It helps in selecting suitable initiatives and encourages the implementation of digital technologies(Kindermann *et al.*, 2020). While some studies have started recognising the importance of digital orientation, studies delineating how digital orientation influence innovation through data-driven technologies are scarce (Ghasemaghaei and Calic, 2019; Coskun-Setirek and Tanrikulu, 2021). Digital orientation can have a broad impact on innovation management, making them a complex and debatable topic that needs further development from a research perspective.

Moreover, literature on digital innovation has majorly analysed the data-driven innovation concept from a technical, architectural or information system perspective(Lyytinen *et al.*, 2016; Wroblewski, 2018). The managerial perspective of data-driven innovation is scarce(Khin and Ho, 2019; Mubarak and Petraite, 2020). Therefore, the motivation behind this study is the infancy stage of literature on data-driven innovation and the growing importance and need for data-driven innovation in organisations (Khin and Ho, 2019; Kindermann *et al.*, 2020; Coskun-Setirek and Tanrikulu, 2021). Along this line, this study addresses the following research questions:

RQ1. What factors drive digital orientation in organisations?
RQ2. Does digital orientation translate digital technologies into improved innovation performance?
RQ3. What are the contingent variables the facilitate the adoption of digital technology and better innovation performance?

To answer the above research questions, this study is carried out with two main research objectives. The first objective is to understand the influence of digital orientation and digital technologies on innovation performance. The second is to explore the contingent variables that positively influence technology adoption and better innovation performance. Drawing from organisational learning theory and dynamic capability theory, our central argument is that the digital orientation of firms helps in the adoption of digital technologies that generate data-driven insights. Further, data-driven insights play a crucial role in improving innovation performance in a dynamic environment through exploring and exploiting opportunities. Firms should align their strategies with requirements of new capabilities for improving performance (Akter et al., 2016). The present study investigates two key mechanisms (digital orientation, data-driven insights) through which digital technologies can affect explorative and exploitative capabilities of organisations that in turn influence innovation performance. We, therefore, apply the case study approach of Situation-Actor-Process (SAP)-Learning- Action-Performance(LAP) given by Sushil (2000). SAP signifies the complexities and interactions among the factors affecting data-driven innovations. In contrast, LAP brings out the areas of learnings that lead to the suggested actions needed to improve the pace of data-driven innovation at the organisations. The SAP-LAP framework helps to build up a picture of possible traverse from "as is" situation to "to be" state, which can help practitioners and policymakers enhance data-driven innovations.

The novelty of this study to the existing state of the field can be summarised in the following ways. First, it offers a new conceptual framework that links data-driven innovations to digital orientation and the explorative and exploitative capability of organisations. By empirically examining the framework, the study fills the literature gap by offering evidence of relationships between digital technologies' enabling factors and performance impact. Second, the current study is one of the first studies that provide a comprehensive analysis of data-driven innovations, particularly in the context of the automobile industry. Nowadays, digital technologies in vehicles signify at least 50% of the total value of a vehicle; therefore, it is essential to add knowledge on digital innovation in the context of automobile firms. Thus, the present study identifies the call for assessing and integrating the significance of digital technologies with data-driven innovation. Third, the study integrates organisational learning theory and dynamic capability theory within the SAP-LAP framework to explicate the relevancy of the concepts to the context primarily due to the distinctive and disruptive nature of the emerging nature of digital technologies. Thus, the contribution and novelty of this study lie in inquiring about the current situation of data-driven innovations in firms and analysing the interaction among involved actors and processes to understand the issues surrounding actors to improve innovation performance.

The remaining part of the paper is organised as follows. Section 2 reviews the extant literature on data-driven innovations. Section 3 presents the methodology and introduces the study conducted in the case firm. Section 4 presents findings from the application of the SAP-LAP tool, followed by a discussion and implications in Section 5. In Section 6, conclusion and limitations and future research directions of the study are presented.

2. Theoretical Foundation

This section initially presents the theoretical background of organisational learning theory and dynamic capability theory. Later, the relationships between digital orientation and data-driven insights, the relationship between data-driven insights and explorative and exploitative capability and the relationship between explorative and exploitative capability and innovation have been reviewed, followed by an assessment of recent literature on data-driven innovation.

2.1.Organisational learning theory

Organisational learning theory, proposed by Huber(1991), emphasises organisational learning capability that competitors could not easily imitate. The theory reports that processing novel data and gaining insights from it enhance firms' learning which is the basis for their innovation performance. Advanced digital technologies can help generate insights from data, therefore an essential driver of innovation. Insight is an experience that derives during problem-solving and assists in finding a solution to the problem(Ghasemaghaei and Calic, 2019). It is a feeling of accuracy, pleasure, ease, suddenness and confidence in problem-solving (Topolinski and Reber, 2010). Developing the understanding of the relationships between the elements of a problem within a context, model or scenario, practices can get insights to solve a problem (Köhler, 1970). Firms must consider developing insights as a dynamic process that will foster organisational learning capabilities and help them innovate successfully. Recently, several firms have employed novel digital technologies to exploit extensive heterogeneous data in almost real-time(Tortora *et al.*, 2021). Usage of novel digital technologies facilitates firms to extract novel ideas and offer improved understanding of markets, customers, products, and services essential to innovate and assist firms in improving their capabilities to develop novel products or refine the existing offerings. In this study, organisational learning, given by Huber (1991), has been applied as it emphasises organisations' ability to innovate through generating novel insights by processing data.

2.2.Dynamic Capability Theory

Dynamic capabilities imply knowledge creation processes, especially in a highly volatile environment. Teece *et al.*(1997) defined dynamic capability as "the firm's ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments (p.516)". Dynamic capabilities facilitate firms to create novel, situation-specific knowledge that constitutes new sources of competitive advantage(Teece, 2007). Dynamic capability enables a firm to exploit existing competencies and simultaneously explore new competencies as well as reconfigure organisational resources to seize existing and emerging opportunities. As per dynamic capabilities, the essential capabilities needed for innovation are exploitation and exploration. Exploration and exploitation are perceived as a factor to enhance organisational performance and innovation. Exploitative activities enhance and improve available knowledge and skills, whereas exploration activities discover novel ideas. Exploitation refers to refining knowledge, skills, processes, and structure for innovation in the current offerings, and exploration relates to acquiring knowledge, skills, and processes completely new to the firm and adding variety, flexibility, and novelty to the product

innovation. Exploitation requires firms to harness their existing resources, skills and competencies and enhance their product offerings, whereas exploration demands considerable efforts to generate unique and novel products through novel insights. Using dynamic capability theory, the study attempt to understand whether explorative and exploitative capability enable organisations to develop and improve their innovation performance.

2.3.Digital orientation and data-driven insights

The organisational learning theory within innovation literature indicates that successful adoption of digital technologies for fostering innovation depends on the digital orientation of firms in an uncertain environment. Grounding on the definition given by Gatignon and Xuereb (1997), digital orientation is conceptualised as firms' orientation in digital technology context and is defined as "a firm's commitment toward applications of digital technology to deliver innovative products, services and solutions". The dimensions of digital orientation, namely technology scope, digital capabilities, digital ecosystem coordination and digital architecture configuration, address the features of digital devices that they offer to the customers, describes the human and organisational aspects of technology, suggests combinations of various digital devices that can be used to build digital platform and enable digitalisation through organisational structure and responsibilities that are needed to cater technological change.

Digital orientation of organisations facilitates the co-creation of knowledge and solutions through collaboration among multiple entities and technological investment to address a wide range of needs of manufacturing organisations (Trabucchi and Buganza, 2019). A convergence of various technologies such as virtual reality, blockchains, wearable technologies, chatbots, business process automation, and machine-to-machine interactions through the internet of things are helping firms create data-driven insights(Khin and Ho, 2019). Data-driven insight signifies the uses of current and historical data in an organisation to move from uncertainty (not aware of the solutions) to uncertainty (awareness about the solutions of the problems(Ghasemaghaei and Calic, 2019; Köhler, 1970). On the basis of this definition, digitally oriented firms are considered more open to digital technologies and tend to embrace digital initiatives quickly with commitment. Digital technologies such as internet of things, cloud computing, wireless networks, artificial intelligence, augmented reality, cyber-physical systems, big data analytics and simulations are some of these key digital technologies that profoundly offer data-driven insights.

Drawing on the organisational learning theory, the literature posits that firms with digital orientation develop technical expertise and technological capabilities to create value for customers by producing three main types of data-driven insights: descriptive insights, predictive insights, and prescriptive insights(Ghasemaghaei and Calic, 2019). Descriptive insights majorly emphasise using past historical data to understand the current state of the business situation so that development becomes apparent in reports. Predictive insight offers understanding about future probability and trends by analysing possible relationships among variables. In contrast, prescriptive insights give potential business solutions and suggest implications of implementing these solutions. In sum, digital technologies and the broader use of digitised data facilitate firms to generate actionable insights to transform operations/functions/models/processes and activities(Blichfeldt and Faullant, 2021).

2.4.Data-driven insights and exploration and exploitation capability

Firms' ability to identify underlying relationships and patterns in the data facilitates better interactions with the market and available opportunities(Clauss *et al.*, 2021). For example, scanning consumer needs can help organisations identify possible opportunities and refine current routines to make innovations. Deeper insights about the customers, competitors, and environment play an essential role in developing capabilities for innovation(Khin and Ho, 2019). New digital technologies, internet of things, big data, RFID, additive technologies produce a massive amount of data and can help firms in delivering data-driven insights by discovering patterns in the data set (Kumar et al., 2021). This descriptive insight generated by digital technologies may affect firms' ability to exploit existing assets base or explore novel options to compete in the marketplace(Guo *et al.*, 2021).

Novel digital technologies, such as IoT, Machine Learning, Big Data use data aggregation and data mining techniques to offer insights about the past and answer the question of "what has happened". Predictive insights apply statistical models and forecasting methods to predict the future and answer "what could happen" and prescriptive insights usage optimisation and simulation techniques to answer "what should be the future course of action". The predictive insight helps firms forecast their sales trends and overall performance, leading to the development of new products or refinement of existing products. Similarly, prescriptive insights help firms to find the best solution by showing a variety of choices. It allows firms to make decisions by offering an optimised result, thereby help a firm to exploit existing resources and explore novel resources to improve performance. For instance, insights gained from

simulations help firms assess different scenarios and refine and extend current competencies, technologies, and paradigms or experiment with new alternatives and adopt new processes, products, and services. Firms that are able to successfully able to generate business insights can develop their exploration and exploitative capability.

2.5. Exploration and Exploitation Capability and Innovation Performance

Given that dynamic capability helps firms transform existing resources into novel functional competencies, both exploration and exploitation are considered as dynamic capability that helps in meeting the changing market requirement. Innovation is crucial for organisations working in a dynamic environment and largely contingent on the firm's explorative and exploitative capability(Ramos and Blind, 2020). Innovation can happen through the explorative capability to satisfy the evolving demand of customers and integrate novel technology in products, services and processes that are not currently adopted(Zhang *et al.*, 2021). Similarly, firms can engage in innovation through the exploitative capability to meet the customers and current market demand by expanding the existing products and services and refining and improving the efficiency of the processes. Compared to exploratory innovation, exploitative innovation is based on knowledge and information associated with primary knowledge and skills(Ghasemaghaei and Calic, 2019).

Exploration and exploitation are perceived as factors to increase organisational performance and are considered variables that positively impact innovations(Guisado-González *et al.*, 2017). From the idea generation to the successful launch of a new product, exploration and exploitation capabilities are a central theme of product innovation. Exploitative activities improve available knowledge and skills, whereas explorative activities discover new knowledge. Levinthal and March (1993, p. 105) defined exploration as "the pursuit of knowledge of things that might come to be known," and exploitation as "the use and development of things already known." Grounding on these definitions, in this study, "exploration capabilities" have been defined as the firms' ability to adopt new processes, products and services that are unique and "exploitation capabilities" have been described as the firms' ability to improve their existing resources and processes continuously(Brunetti *et al.*, 2020). By developing exploration capabilities, firms can enhance their degree of product introductions, introduce novel products and services into the market, overcome prior limitations and enhance both value delivery to customers and the extension of products and services to new customers. Exploration includes large and expensive investments in the

development of innovations that bring a greater degree of novelty. Exploitation offers firms a chance to leverage their existing resources, thereby ensuring their immediate survival through the commercialisation of knowledge, which opens avenues for product innovation. Table 1 presents some of the recent studies conducted in the field of data-driven innovation.

Table 1: Studies on data-driven innovations

Authors	Purpose	Methodology	Findings
Babu *et al.* (2021)	To understand the data-driven innovation process in the manufacturing industry	Semi-structured interviews, Multiple Industry, UK	The steps in data-driven innovation are sequential and interlinked.
Baday Yıldız *et al.*(2021)	To assess whether and to what extent innovation behaviour of family firms differs from the similar types of behaviour observed in the advanced world	Survey, multiple firms, Turkey	Internal competencies, collaboration and public support positively influence innovativeness and minimise innovation barriers among family firms.
Blichfeldt and Faullant(2021)	To assess the relationships between technology adoption, product and service innovation and competitive advantage	Survey, Process Industry, Denmark	Digital technologies generate product and service innovations in the low-tech sectors, whereas digital technologies directly improve performance in the high-tech sectors.
Boeker *et al.* (2021)	To investigate the influence of knowledge sources and the context of the digital technologies in which they are developed on the quality of knowledge acquired by entrepreneurial ventures	Survey, Biotechnical firms, USA	Parent firm and co-inventor innovativeness influence venture knowledge quality.
Bresciani *et al.(*2021)	To perform bibliographic coupling analysis to understand the use of big data for the co-innovation process	Literature review	Three thematic clusters, which represent bigdata as a knowledge creation enabler within co-innovation context, big data as a driver of co-innovation processes based on customer engagement and the impact of big data on co-innovation within the service ecosystem
Coskun-Setirek and Tanrikulu, (2021)	To propose a process model for digital innovation-driven business model regeneration based on the design science research approach	Mixed-Method, Construction Industry, Turkey	Offers a model to assess the impact of potential digital innovations on current business models

Chirumalla (2021)	To understand how firms develop and implement new process innovation and assess improvement opportunities through the better adoption and implementation of digitalisation.	Case study, Sweden	Offer insights about required dynamic capabilities for the smoother transformation
Ranta *et al.* (2021)	To assess how do digital technologies enable firms to improve circularity and how do digital technologies catalyse business model innovation/	Case Study, Multiple Industry, Finland	Develop a model of four key types of business model innovation for circular economy
Su *et al.* (2021)	To assess the role of big data analytics capabilities in improving organisational performance through the mediating role of dual innovations	Survey, Manufacturing Industry, China	Bigdata analytics capabilities have a direct and indirect effect on organisational performance. Further, dual innovations positively mediate these relationships
Usai *et al.* (2021)	To assess the impact of digital technologies on innovation performance	Survey, Multiple Industry, Italy	Digital technologies have a very low influence on innovation performance, whereas R&D expenses are the significant predictor of innovation.
Tortora *et al.* (2021)	To examine how distinct knowledge-based capabilities assist the process in developing digital innovation.	Survey, Multiple Industry, Italy	Knowledge acquisition capabilities positively affect digital innovation, and social media moderate this relationship.
Mikalef *et al.*(2020)	To assess if big data analytics capabilities can improve their innovation capabilities and how information governance moderates their relationship.	Survey, Multiple Industry, Norway	Big data analytics capabilities have a significant positive impact on incremental and radical innovative capabilities.
Mubarak and Petraite, (2020)	To examine the role of technological orientation and technological absorption capacity in the association between digital trust and open innovation	Survey, Cross Country, Electric and electronic industry	Digital trust positively influences a firm's open innovation. Technological orientation moderates digital trust and open innovation.
Ramos and Blind (2020)	To examine the impact of the right to data portability on data-driven innovation response of online platforms	Secondary data of Spotify Germany	Firms need to invest in two forms of data-driven innovation due to data portability to deal with competition.

	through influencing competition		
Trabucchi and Buganza, (2019)	To understand how digital technologies act as a trigger factor in enabling an effective and efficient innovation process	Case Study, Multiple industries	Data that are by-products during the leading service offered can be exploited for the innovation process.
Ghasemaghaei and Calic, (2019)	To examine the impact of each big data features on innovation competency through data-driven insight generation.	Survey, Multiple industries, Canada	Data velocity, variety and veracity, improve data-driven insight generation
Khin and Ho (2019)	To measure the impact of digital orientation and digital capability on digital innovation and assess the mediating role of innovation on organisational performance and digital orientation and digital capability.	Survey, IT firms, Malaysia	Digital orientation and digital capability positively influence digital innovation. Also, digital innovation mediates the impact of technology orientation and digital capability on performance
McLoughlin *et al.(*2019)	To assess the potential of data-driven innovation in the social sector	Review	Presents opportunities of the data revolution and challenges involved in the data revolution and the issue and problems to be overcome by firms

2.6.Research Framework

We aim to develop an understanding of the influence of digital orientation and digital technologies on innovation performance and explore contingent variables that positively influence technology adoption and innovation performance. Therefore, based on the discussion given in the previous sections, a research framework-based organisation learning theory and dynamic capability theory principles is shown in Figure 1, is used in framing an investigation and analysis of the firms; actions and for drawing appropriate conclusions. Organisational learning theory suggests that organisations' digital orientation helps firms develop data-driven insights, facilitating organisational learning. On the other hand, organisational learning through data-driven insights enables firms to build explorative and exploitative capability, a type of dynamic capability that helps organisations improve innovation performance in a dynamic environment.

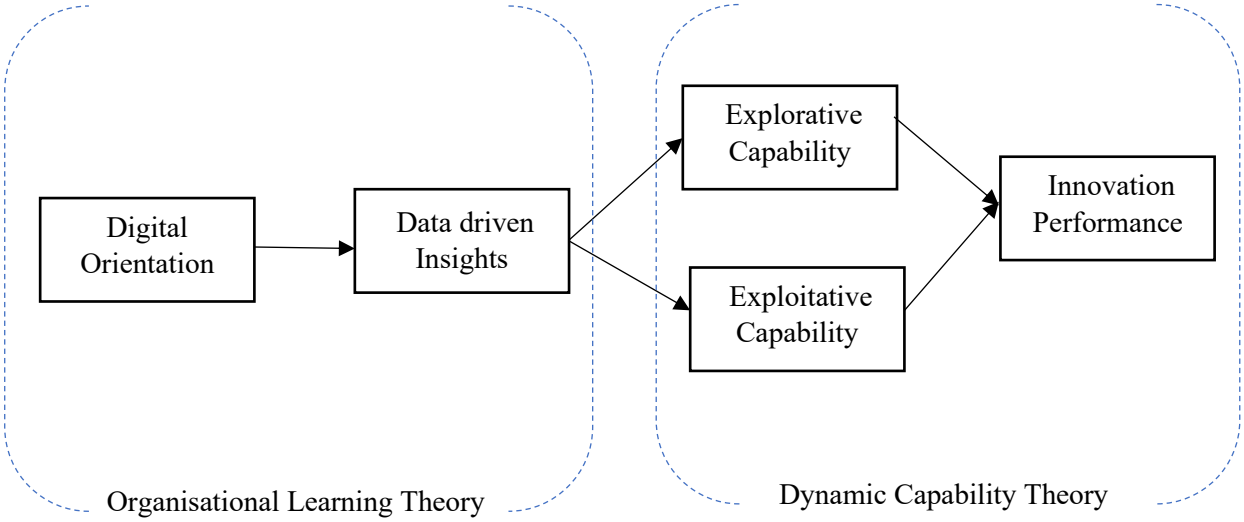

Figure 1: Research Framework used in this study

3. Research Methodology

The study employed an in-depth case study approach (Yin, 1981; Eisenhardt and Graebner, 2007; Voss *et al.*, 2002) with the purpose of 'microscopic' assessment of drivers of digital orientation (RQ1), the relationship between digital orientation and digital technologies to improve innovation performance in organisations (RQ2) and to discover contingent variables to facilitate the adoption of digital technology and innovation performance (RQ3).

An in-depth qualitative case study is considered appropriate as the empirical evidence or theoretical development on dynamic capability for data-driven innovation has been limitedly explored (Eisenhardt and Graebner, 2007). The use of a single case study is justified in this study as it offered a holistic, in-depth inquiry into the phenomenon (Mishra et al., 2021). A case study enriches operations management literature by capturing rich, detailed information related to the decision-making of an individual firm that is missed by other types of research studies(Voss *et al.*, 2002). Siggelkow (2007) also suggested that single case studies can offer compelling data to examine theories as long as the selected case holds unique attributes required to meet specific objectives of a firm. Therefore, using a single case is justified as the depth of knowledge cannot be captured purely by the statistical analysis of any survey.

3.1. Research Context

Data-driven innovation is progressively transforming the automotive industry, and therefore firms are increasingly investing in different digital technologies to meet consumer demands.

Nowadays, digital technologies in vehicles represent at least 50% of the total value of a vehicle. Moreover, the stringent environmental policies on climate changes opened the door for firms to utilise data-driven insights for minimising greenhouse gas emission and carbon footprints, using energy resources efficiency, maximising efficient usages of renewable resources and improving sustainability. Though often not realised, automobile firms deal with rich data sources and have kept massive amounts of data in their repositories. In automobile firms, data acquisition, sharing, and exploitation promise to create value in various supply chain activities, from optimising value chains in the global supply chain and services to efficient labour usage and customised customer relationships. The rapid rate of innovation resulting from digital technologies is an essential phenomenon in the industry's 140-year history, making the sector most suitable for conducting studies on digitalisation.

3.2.Case Selection Strategy

The selection of a case study was made using a purposive sampling strategy. An automobile firm was selected to demonstrate the application of the proposed conceptual model. The selection of case firm follows the following stringent criteria: i) case firm should have extensive experience in its respective domain and is known for frequent product and process innovation, ii) case firm is in the process of digital transformation, formulated an overall strategy for digitalisation iii) firm should be willing to provide access to key informants who can share experience related to investigated phenomenon and iv) firm should be overall representative of automobile industries, which could support the generalisability of findings.

After applying these screening criteria, an automobile manufacturing firm with a considerable market share in the Indian automobile industry has been considered for this study. Started with manufacturing a single model, the case firm (hereafter XYZ Ltd) is now producing a high volume of cars requiring careful integration of many strategic functions to ensure quality and productivity in operations while ensuring safety at all levels. XYZ Ltd. has six manufacturing plants with an annual capacity of 1.5 Mn cars. It has also built up an intense research and development team and developed the capability to work independently to design and manufacture the vehicles.

3.3.SAP-LAP Framework

SAP-LAP framework, developed by (Sushil 2000), is a flexible, interactive method comprising of two phases, namely situation (S), actor(A) and process(P) and learning (L), actions (A) and

performance(P) (Figure 2). The framework facilitates identifying activities that lead to improvement in performance through coordination between situations, actors and the processes involved in the phenomenon (Arshinder *et al.*, 2007; Siva Kumar and Anbanandam, 2020). Several studies have applied the SAP-LAP framework in various problems in the last two decades (Table 2).

Table 2: Application of SAP-LAP framework

Author(s)	Application Area
Singh and Sushil (2021)	To analyse the waste management practices in sustainable firms.
Dhakate and Joshi (2020)	To evaluate the process of organ donation and transportation in hospitals
Gupta and Singh (2020)	To assess sustainability issues in logistics service providers
Kumar and Anbanandam, (2020)	To analyse the multimodal freight imbalance and transport sustainability
Chauhan *et al.(*2019)	To analyse how the industry 4.0 paradigm can be used to solve circular economy issues
Chavan *et al.(*2019)	To examine the state of physical infrastructure and suggest future actions required for attaining sustainable development goals.
Malik *et al.(*2019)	To understand the financial inclusion in India
Chand *et al.(*2018)	To assess drivers of supply chain complexity and its dynamic behaviour

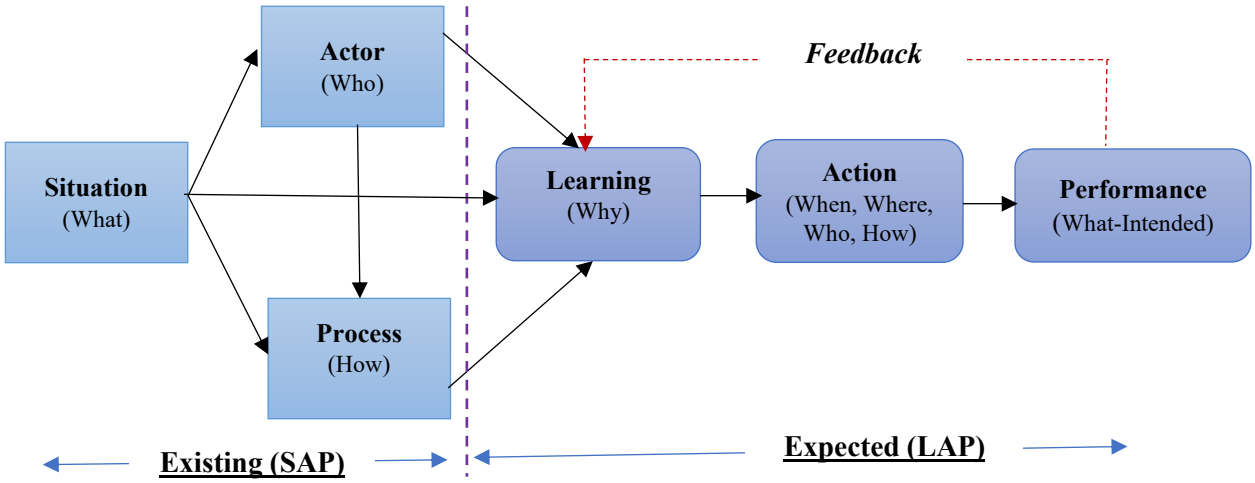

Figure 2: SAP-LAP Framework (adapted from Sushil(2000))

3.4.Data Collection Method

The data were collected from senior and middle-level practitioners using a purposive and snowball sampling strategy. The purposive sample is the most prevalent sampling strategy where the sample size relies on data saturation. Studies recommended that saturation occurred

within the first twelve interviews (Morse and Field, 1995; Guest et al., 2006). Semi-structured, in-depth interviews were conducted by the two researchers, where one conducted the discussions, and the other facilitated the process through notes preparation and recording the interviews. Semi-structured interviews offer flexibility and more insightful information while solving complex problems(Eisenhardt and Graebner, 2007; Yin, 1981).

Before conducting interviews, a research instrument was reviewed by 5 experts (3 academicians and 2 practitioners) to review the interview questions. A pilot interview was conducted with a practitioner to test the research context, the language used by participants, and clarify the terminology used in interview questions. After the pilot interview, an interview participant shared his experience, few changes in wording were made to increase the clarity of some questions. The human resource manager was the first point of contact for conducting this study, and she nominated knowledgeable participants for this study. Key personnel with extensive experience in managing innovation or part of the digitalisation in the case firm were contacted. Before conducting interviews, a cover letter that states motivation, objective, and possible usage of this study has been shared with potential interviewees. In total, 15 interviews have been conducted with experts from R&D, operation, sales and marketing, IT and automation domain of the case firm during the two months of November and December 2020 (Table 3). All the interviews were carried out over zoom software, a virtual communication platform, and these interviews lasted around 90 to 120 minutes. The duration of the interviews varied based on the participant's willingness to discuss their insights related to data-driven innovation.

Table 3: Sample Characteristics

Particular		**Number**
Domain	Automation	2
	Information Technology	3
	Production	4
	Quality	2
	Research & Development	4
Designation	Vice President/ Assistant Vice President/ Executive Vice President	4
	General Manager/ Deputy General Manager	2
	Manager/Senior Manager	9
Education	Undergraduate	6
	Masters	9
	More than 20 Years	3

Experience with existing organisation	10- 20 Years	2
	5 Years- Less than 10 Years	11

3.5.Case Protocol

A case protocol was developed with the help of related literature and experts' opinions. It included a set of guidelines (procedures and rules) and a research instrument that can be used to structure and govern a case research project and maintain uniformity in data collection and analysis(Yin, 1981). Due to the word limit, a detailed protocol is not given in this paper; however, major research questions used in the research instrument is given in Table 4.

Table 4: Major questions used in the research instrument

Elements	Questions
Situation	- How does your organisation coordinate with the digital ecosystem? - What drives (influencing factors) firms to develop digital orientation? - What kind of digital technologies are employed in your organisation? - What are the functional areas where your organisation deploys digital technologies? - How does your organisation leverage the scope of digital technologies, create or adapt to digital technologies? - What kind of data-driven insights are used in your organisation? - How does your organisation utilise data-driven insights in explorative and exploitative activities? - Is there any relationship between explorative and exploitative activities and innovation performance?
Actor	- How much the top management of your organisation is committed to developing digital orientation? - How do employees of your organisation align with the goal of data-driven innovation? - What are the roles of stakeholders in facilitating data-driven innovations? - Are any external stakeholders involved in the deployment of digital technologies?
Processes	- What are the processes adopted by your organisation in developing digital orientation? - What are the tools and measures adopted by the firms to develop data-driven innovation?
Learning	- What are the factors influencing the implementation of digital technologies? - What are the needs and requirements of digitalisation at various levels of an organisation? - What is the importance of digital technology in encouraging data-driven innovation? - Is there any factor influencing your organisation’s ability to transform explorative and exploitative capability into innovation performance?

Action	-	What should be done to implement various technologies at various levels of an organisation?
	-	What should be done to facilitate data-driven innovation in your organisations?
Performance	-	How can the innovation performance be improved by adopting digital technologies?
	-	How does the adoption of digital technology impact overall organisational performance?

3.6. Error & Bias Control Procedure

To ensure the reliability and validity of the study, attention was given to avoid any errors & biases present in different phases of the case study (Voss *et al.*, 2002). The research instrument was carefully prepared to avoid any leading questions and wording bias. Further, it was reviewed by experts to make it simple, unambiguous, and bias-free. During the interview, the ordering of questions was carefully planned. Generic questions were asked first, and then specific questions were asked to avoid any question ordering bias. All the open-ended questions allowed participants to express their opinions honestly rather than merely agreeing or disagreeing with the researcher's opinion(Yin, 1981). The similarity between different questions was avoided by carefully framing the questions so that participants could perceive distinctly different questions; therefore, responses were free from habituation bias. Further, the data analysis & findings were prevented from confirmation bias by analysing data with clear and unbiased mind by two researchers. A copy of the final case study report was shared with case study participants to evaluate their response to documented findings and ensure that data reporting is not affected by pre-existing assumptions(Eisenhardt and Martin, 2000).

The study was prevented from common method bias by maintaining response anonymity and eliminating evaluation apprehension from participants (Podsakoff *et al.*, 1990). Before conducting the interviews, we conveyed to participants that there are no right or wrong answers; therefore, they should respond honestly to the questions. Further, leading, biased, or closed-ended questions were removed from the questionnaire to avoid any socially desirable agreeable responses. Further non-response bias was prevented as participants for this study were carefully recruited to address the research questions. Knowledge and experience of participants and their careful selection through formal channels ensured the absence of non-response bias in this research.

3.7.Data Analysis

The study employed interview protocol as a recommended strategy for increasing the reliability of the case study(Yin, 1981). To improve the validity of research, data were collected from a review of recent studies and experts through interviews. To maintain consistency in data, a single researcher conducted all the interviews; however, the collected data were analysed by two researchers in the analysis process.

Both literature and interview transcripts were used for the identification of themes and coding categories. Before using the interview findings, transcripts and summaries were shared with the interviewees for their final approval. Once approved by the interviewees, data were then rearranged with coding to categorise it meaningfully. Literature, documents, and interview transcripts were applied to identify themes and coding categories to ensure triangulation. The questions and sub-headings from the interview protocol have been used as a starting point for developing categories. Interview transcripts and second data (document, website information) were then clustered into these categories. While clustering the information, clustering was discussed iteratively to understand the different perspectives to prevent bias. The analysis was concluded when two researchers arrive at the same conclusion to strengthen the findings.

3.8.Validity and Reliability

The quality of a case study relies on the ways issues related to internal validity, construct validity, external validity, and reliability have been tackled by the researcher(Yin, 1981). Internal validity was ensured by doing pattern matching and explanation building from extant studies. Construct validity was established by combining and recollecting evidence from multiple sources in case study research. Data triangulation and seeking additional clarification improved the construct validity of the study. The use of an interview guide and proper documentation of protocol and usages of multiple data sources for data collection ensured the reliability of the study.

4. SAP-LAP Analysis in the Case organisation

In this section, the analysis of XYZ Ltd. using the SAP-LAP framework has been done in the context of data-driven innovations.

4.1. Situation

The situation implies the current status quo of the digital orientation in promoting data-driven innovation in XYZ Ltd. As the firm is rooted back more than three decades in time, most of the case firm's operations were initially based on manual operations. Digital orientation of

firms, in terms of digital capabilities (human and organisation aspects), technological investment, internal management skills and digital architecture helped in the gradual transformation of manually operated systems to the automatic platform-based system. Competitive pressure, new environmental regulations, globalisation and consolidation of platforms are some of the challenges that XYZ Ltd. has currently been facing. Case firm digital orientation is centred around addressing basic concerns like finding growth amid increasing competition, making the right technology choices within a changing regulatory environment while meeting changing societal preferences, and selecting mega-platforms using consolidation and stretching beyond segment coverage.

Further, growing environmental dynamism makes it difficult for XYZ to assess the present and future state of the environment and encourage digital orientation to mitigate the potential adverse impact of environmental dynamism. For example, electric vehicles (EVs) made customers wait for EVs without having any fair idea about the price and challenges pertaining to its required infrastructure. XYZ operates in an industry that exhibits greater environmental dynamism, such as rapid changes in technology, market, competition, and customer expectations; therefore, top management has to make quick strategic decisions and develop innovative strategies to build rapid response to compete in the markets. The strategic orientation focused on digital technologies increases communication effectiveness, planning and dynamically enhancing the ability to respond by generating and utilising data-driven insights through digital technologies.

From maintaining a centralised service-based dealer management system to transforming business through emerging digital technologies like artificial intelligence, internet of things, machine learning, XYZ Ltd has continuously worked towards its digital orientation. Ongoing COVID-19 pandemic has also reemphasised the firm's strategic focus. Now digital technologies are at the centre of its all strategies, whether it's related to customer acquisition, customers' need identification, design, and new product development, manufacturing, branding, marketing, dealer management. To imbibe innovative culture, XYZ identifies innovative and cutting-edge solutions through tie-up with start-ups, which are futuristic and customer centric. Risk-taking and wall-free culture promote learning, encourage experimentation with novel digital technologies, and foster learning to develop capabilities needed to successfully adopt digital technologies. Inferred from the personal interviews, SWOT analysis, a strategic planning technique, was applied to analyse the situation in the

context of the digital orientation of XYZ through potential usages of digital technologies (Table 5).

Table 5: SWOT Analysis of XYZ Ltd. in the context of data-driven innovation

Strengths	Weakness	Opportunities	Threat
- Large number of manufacturing assets for producing high volumes. - Diverse product portfolio. - Highly automated facilities to exploit existing resources for innovation - Access to novel digital technologies to explore novel products and processes for innovative activities. - Strong R&D team to engage in explorative activities - Close coordination with Vendor plants to exploit existing opportunities to promote innovation - Availability of adequate IT infrastructure.	- Few processes are manual operations and hence are operator dependent - Lack of digital capability for digitalisation,- dependency on outsourcing for these activities is high. - Lack of synchronisation between initial projections and actual demand from production lines that hinder firms from exploiting existing resources in an optimal way	- Large amount of data being generated from process in manufacturing, which can be streamlined and put to use for fruitful exploratory and exploitative activities. - Access to novel digital technologies technology through parent firm that help firm to bring innovation by developing exploration and exploitation capability - Opportunities to replicate digital strategy of parent firms to foster data-driven innovation - Cash flows to invest in advanced technologies	- Data security as large amount of data is being generated pertaining to vehicles being produced every day. - Tough competition is coming up in the Indian market with manufacturers coming up with advanced technology setups while the company being for three decades in the country has many old systems.

Drawing on the interviews' findings, there is a need to develop a digital ecosystem and digital competencies to promote digital technologies. With the requirement of the new model's introduction on production lines, the lines are required to be more flexible with minimum capital investment every time. With a shorter product life cycle, the new model development

time has narrowed timelines that required a robust and flexible manufacturing process. Advanced quality control systems using digitalisation techniques are needed to ensure quality and data repositories for such a massive production volume. XYZ Ltd is developing artificial intelligence and computer vision-based quality inspection platforms to attain zero-defect production to generate data-driven insights.

Further, the synchronisation between ordering cycles and production planning is essential to control inventory holding costs as well as to avoid line stoppages due to part shortage. With increased environmental concerns and stringent regulatory requirements for compliance, continuous improvements are required in the manufacturing process. In view of the above, the overall efficiency of each shop and reduction of rework is especially important towards sustenance. Systems should be in place to monitor energy consumption, and conservation measures to be checked and implemented horizontally. XYZ is developing artificial intelligence /machine learning-based platforms and solutions for mobility /digital services in this context. With increased regulatory requirements in the stock listings, compliance with sustainable practices is essential to gain investors' confidence. The recent lockdown due pandemic of Covid-19 has resulted in huge, fixed cost per vehicle for the company. Digital technologies can be put in place in different functional areas to develop data-driven insights that can be used for different explorative and exploitative activities to foster innovation. For example, machine learning techniques can be used to establish a system for rapid prototyping economically and conveniently.

Similarly, digital technologies can generate insight that can be used to develop a system for minimising equipment running costs in an idle condition where 24 hours operations are not required during idle operations. Further, re-starting the manufacturing operations with compliance to precautionary norms related to the pandemic spread has been a new experience and a challenging job. Post COVID-19, digital technologies can help in fostering data-driven innovation to combat this challenge.

4.2. Actors

The actor in the SAP-LAP framework answers the question of "who" are the central actors responsible for handling situations(Sushil, 2000). Actors are the personnel who play a key role in strategy formulation and implementation related to the adoption of digital technologies. Along this line, actors shall be the decision-makers for developing digital culture, bringing digital orientation, and selecting and implementing digital technologies for data-driven

innovations in the organisation. The actor of data-driven innovation in a firm can be classified into internal stakeholders and external stakeholders.

4.2.1. Internal Stakeholders

Top management of XYZ has started building digital orientation by planning to integrate digital technologies with its core business strategy. It has set a direction, defined a strategy for digital technology implementation, secured investment, and ensured alignment with distinct functional areas to foster a digital culture. Top management takes strategic decisions related to acquiring novel technologies, draws an overall roadmap, and develops innovative and learning culture to adopt technologies to achieve the desired outcome. The middle management has been delegated the job of selecting systems and sources and given responsibilities to build digital capabilities through training & development, knowledge sharing, openness, and employee participation. Once the middle management finalises the systems and sources, the senior management reviews the proposal and submits it to the top management (Vice president and above) for final approvals before the implementation. Further, R&D department plays an important role in designing and executing product development strategies and innovations in the processes involved. The product's design specification needs to be carefully fixed by the R&D engineer after working closely with marketing, quality & production divisions. R&D engineer also needs to focus on making the new products and achieving the skill-up for adopting new technologies keeping cost leadership position of XYZ Ltd.

4.2.2. External Stakeholders

In many cases, consultants, line integrators and equipment manufacturers also play a crucial role in advising the best and advanced digital technologies available in the market and building capabilities to adopt these systems. Consultants and trainers conduct training sessions and development activities to guide employees on several explorative and exploitative activities that can be performed through insights generated through digital technologies. In few cases, external agencies like Government and ISO certifying agencies also suggest or mandate the implementation of systems for compliance purposes. Parent firm also guides XYZ and offers inputs on integrating digital technologies, utilising data-driven insights, and several explorative and exploitative activities conducted in the case firm. For example, strategies to incorporate digital technology, develop digital capabilities and build a digital ecosystem are jointly decided

with the parent firm. Almost 90% of the plant and machinery installed is designed by Japanese manufacturers, and a lot of input flows through knowledge sharing sessions from the overseas plants of parents' global operations. In fact, regular interactions and knowledge sharing occur with another subsidiary of the parent firm to benefit from horizontal deployment and cross-sharing practices.

4.3. Processes

The major processes of data-driven innovations are encircled around the core process of manufacturing and selling passenger cars in the domestic and export markets. With the assessment of customers' needs and requirements through market research to final delivery of car, XYZ Ltd. relies on three approaches to digital innovations, namely integrating novel advanced digital technologies into automobile, optimising and improving manufacturing and supply chain and adapting its business model based on the external market pressure. While XYZ tends to be at the forefront of technological advances, digital technologies are stimulated by factors such as organisational culture and leadership commitment. To gain the effectiveness of implementing digital technologies, top management and employees at the senior level are thoroughly involved in adopting digital technologies. XYZ applies an open-door policy and supports with required investment to foster innovations. Staff are given the freedom to innovate on shop floor/ assembly line or use their learning from their colleges in the workplace, and consequently, several products, such as robotics, are the result of these practices. Some of the innovation outcomes include automated multi-level parking, welded planks for overcoming fatigue, integration of several digital platforms to reduce carbon emission, minimise water consumption, and increase fuel efficiency. For example, XYZ Ltd. has decreased over 9 lakh tonnes of CO_2 emission over the past decade by introducing CNG, LPG and Smart Hybrid vehicles. Further, XYZ Ltd follows systems and processes implemented at its parent firm to promote innovation, which is quite different from its systems. For XYZ Ltd, innovation does not necessarily have to be radical or breakthrough but rather, most of the time its incremental in nature, which requires regular involvement of employees and promotion of innovative and learning culture.

At XYZ Ltd., digital technologies play a significant role to capture different data set for real-time monitoring and control of distinct functions, ranging from planning to customer relationship management. For example, many digitalisation techniques are used to monitor and

control the equipment health, thereby help in performing preventive and predictive maintenance activities. Similarly, digital technologies facilitate tracking of over 40,000 vehicles to manage the dispatch. Apart from the core processes presented, there are support functions, including administration and finance, where data-driven insights through digital technologies play a crucial role in managing innovative activities.

4.4.Learnings

The learnings from the current situation and processes help to understand "why" the current state of the system exists and suggest action points to improve the systems. Presently, XYZ majorly emphasises the adoption of digital technologies to improve operations and production quality. Integration of digital technology starts with the design phase, as the operation will be efficient only when both the product and process are designed correctly. The use of additive manufacturing processes and 3D printing are increasingly attractive strategies to get the designs right the first time, reducing the cost of rework and reducing the development time. The extensive use of Uni graphics and other CAD software is widely used to check the fitment of parts in a virtual platform before starting the actual physical assembly.

Growing competitive pressure and increasing environmental dynamism also require an organisation to work increasingly towards developing production lines, especially the body shops, which are easily adaptable to flexible model manufacturing with minimal investment of time and cost. There is also a need for technologies to ensure that the integration of complex parts is done seamlessly. With the regulatory requirements in place, these technologies are also required to keep a data repository for the records of parts fitted in every vehicle. As the organisation is increasingly eyeing global markets, these regulatory requirements are getting more and more diverse. Another aspect of technologies is required to monitor and log all the defects appearing even on the smallest station so that its occurrence and impact on further processes can be controlled at the right time. In the case organisation, the volume produced is very high; hence, defect identification is crucial to minimise the spread of all WIP vehicles. Moving into other phases, the Production planning needs to be equipped with advanced systems to integrate with the dynamicity of production lines. This is important to control inventory as well as to avoid production losses due to part shortages. Monitoring the health of plants and machinery is equally essential to ensure the efficiency of operations. This is an

overly broad area where the application of advanced digital technologies shall be required to enhance the performance of maintenance functions.

Dealing with the all-new challenges during pandemic COVID-19, the fixed cost of the idle manufacturing facilities was extremely high, leading to considerable losses in Quarter 1 (FY 2020-21) results. However, it would be impossible to eliminate these fixed costs altogether; certain technologies are available to minimise the running cost of idle manufacturing units. In line with dealing with the pandemic scenario, it had been challenging to re-start the operations amidst the employees' safety concerns and the spread of the disease. The use IT technologies to collect health data on a massive scale and integrating it with the gate entry systems had been helpful. Apart from the need and requirements of digitalisation at various levels, the learning through discussion and experience also reflected the factors influencing the implementation of digital technologies, which are summarised in Table 6.

Table 6: Factors influencing implementation of Digital Technologies

	Favourable Factor	Neutral	Against Factor
Technical Factors	- Adequate storage capacity available. - Machine and Equipment have open interface for data communication or can be easily done through maker support. - Existing systems and process are compatible with advanced technologies	- Data Security	- The management fear of confidentiality breach. - Lack of Technical expertise.
Economic & Financial Factors	- Economies of scale in digitalisation. - Realisation of ROI is possible. - Adequate budget availability (respondents are in high number from case organisation).	- Digitalisation increases the manufacturing cost - Budgetary constraints - Huge cost incurred in digital systems cannot be recovered.	

	- Organisation is willing to invest in training and development of the employees	
Behavioral Factors		- Job insecurity - Prolong engagement in conventional process. - Non-realisation of benefits - Lack of trust between management and employees
Strategic Factors	- Strategic Planning for investment in future - Automation do not have adverse environmental effects - Organisation is able to reorganise procedures to support the digital technologies.	- Centralised decision making - Older generations of employees are both reluctant as well as insecure to use the advance technologies

4.5. Actions

Action implies how learning is implemented in terms of a range of changes that can be implemented to improve the processes. The digital orientation of XYZ is reflected through the successful adoption of path-breaking technologies that eventually facilitate the firm to engage in various explorative and exploitative activities. For example, the gradual transformation is visible in the design team through advanced designing technologies. Traditionally the designs were developed in the parent company located in Japan. However, now the new models are being developed from the initial stages by the Indian team itself. XYZ is developing new flexible lines, especially the weld shops, which have been developed on IoT (Internet of Things) concepts where all the robots and jigs are interconnected on a network working seamlessly through the data flow. These Robots are equipped with flexible tools which can change the arrangements just with a click of command to adapt to different car models, thus enabling the manufacturing line to produce car bodies of different models based on dynamic ratio control as per marketing requirements. In the subsequent phases to come, the customer

may track the development of his ordered model through a mobile application. However, upgrading the old manufacturing units remains a challenge for the organisation.

In continuation of usage of sensors as an application of IoTs, the camera sensing technology is also being applied to meet the regulatory homologation requirement through which the punching of chassis number of each vehicle is being verified with actual system data on a real-time basis and images are being stored on cloud servers for future retrievals. The technologies based on a laid down network of devices are also being increasingly used to monitor product quality on a real-time basis. One such example is the weld shop's spot-welding quality check system: WICS (Welding Information and Control System). More than 1000 robots installed in conjunction perform resistance spot welding to manufacture the vehicle body skeleton. Each body has approximately 3000 to 3500 spots in total. The operations involve integrating a considerable number of systems, and the quality of each spot is essential. The WICS system, through a network of connected welding controllers of each Robot, captures the resistance of each spot and maps it with the model data. If the resistance is out of a defined band limit, the alarm is raised, and the systems are checked before continuing the production lines. This system has proven its results in a very efficient manner, and the organisation has been able to implement it across all body manufacturing shops in all plants. Major quality defects have been identified in the first vehicle, and action has been taken instantly to avoid any multiplication.

The digitalisation of ordering systems has also been taken up and is still evolving to enhance the synchronisation between production planning and inventory of bought out parts. Further, digitalisation of maintenance functions has been the priority of the top management off-lately to strengthen the efficiency of operations and equipment uptime. Two major steps have been taken in this regard. First, the advent of ERP based system for Equipment Management wherein all life cycle of any equipment is being captured, and the system has been integrated with IT infrastructure to raise reminders of preventive, predictive and condition monitoring scheduling of all equipment in the facility. Second, the interconnectivity of all the equipment on a network (for example, Ethernet) to monitor the real-time functioning of systems. The entire data related to line operations are captured for analysis in Operation Analysis System. For Robotic systems, the equipment manufacturer has developed a software-based application called Zero Down Time (ZDT), which monitors Robots' health and generates outputs helpful in decision making regarding overhauling or part replacement before the actual failure. Another application of IoT has been explored in building management systems (BMS) where all the utility controls are

done through a SCADA (Supervisory Control and Data Acquisition) system, which is a significant step toward energy conservation and sustenance. The organisation is also taking up steps towards the reduction of fixed costs in idle conditions. One such example is continuous feedback-based systems of vacuum generators for holding parts in Weld and Press lines, thus saving a large amount of compressed air annually. The cost of compressed air to the company is almost three times the electricity cost due to generation losses. There is yet a lot to be done to reduce the fixed cost to the company in idle conditions.

4.6.Performance

XYZ has been gradually implementing digital technologies into its product and process, and the results have been reflected through the improvement in its internal performance and external performance. Internal performance implies the improvement achieved in the systems and processes inside XYZ Ltd through data-driven innovations. Digital orientation of firms helped to implement intelligent technologies to foster innovation that eventually facilitated rapid flows and brought productivity, flexibility, and new dimensions in customer service. Using various sensors to capture the vehicle speed, acceleration and gear position status, R&D engineers were able to develop technology to automate the gear shifting process of a manual transmission with a robotic intelligent actuation linkage mechanism. With the use of automated gear shift technology, XYZ can lessen cost by 50%, reduce the overall weight of vehicle by 30%, and improve fuel efficiency by 5%. XYZ has developed IoT based application, Welding Information and Control System (WICS), in the body shop to facilitate XYZ to monitor and control the spot quality. Insights produced by the system are displayed as a trend graph. Any abnormality observed is raised by the system in the form of alarms and help firms to control the spot-related failures moving out of the shop as zero after implementing this full proof system. A similar IoT based system, Zero-Down time (ZDT), is being planned for health monitoring of Robots, where all the robots will be connected through Ethernet network. This shall boost the efficiency of weld shops in the future.

XYZ firm applies ERP-based application, equipment management system, and equipment maintenance for all XYZ manufacturing units in India. The system keeps a check on each equipment's historical breakdowns and produces descriptive and prescriptive insights, which help us in making future decisions related to overhauling or renewal of systems timely before

the subsequent failure, thereby help to develop explorative and exploitative capability for the firm. Also, this system helps us in deciding the specifications for future lines. Additionally, this gives us reminder emails for scheduled Preventive, Predictive Maintenance and condition monitoring of the systems to maintain the equipment health and ensure their availability for production. Moving further, XYZ has also integrated the spare parts management system into this EMS system. This is again interlinked with the BOM of machines and hence a complete end to end system to ensure 100% spare part availability. The new model development time has reduced from 48 to 60 months initially to 30 to 36 months, thus helping the company to deal with a shortened life cycle of its products.

Further, digital technology-based innovative next-generation HEARTECT platform lowers CO_2 emission, offer superior performance and safety. XYZ is also planning to integrate a digital technology-based International Material Data Capturing system to assess ASR (Automotive Shredder Residue), RRR (Reuse, Recycle and Recover), and substances of concern (like Pb, Hg, Cd, Cr) across all models so that prohibited substances can be identified and eliminated. Digital technologies helped firms to improve the efficiency of operations. For example, overall efficiency (OE) for body shop has improved from 75-80 % to 90-95 % over these years. In terms of external performance improvement, XYZ's market share has been maintained over 50% for the past five years. The production and sales figures have been rising on a year-on-year basis considering the pre-covid figures, majorly due to deployment of digital technologies in its processes which had eventually increased the efficiency in operations. The re-start of operation post lockdown due to COVID, has been very smooth, and the sales figures are encouraging. In sum, using digital technologies and interconnected devices are helping XYZ Ltd. to generate valuable insights, which help firms engage in several explorative and exploitative activities that facilitate innovation in the form of progressive improvement.

5. Discussion & Implications

Growing connectivity, environmental regulations, wireless solutions, intense competition, and heightened customer expectations force firms to transform the way organisations operate and create value for stakeholders. Merely employing advanced digital technologies cannot drive digital transformation, but it is also a strategy that enables a firm to develop learning and eventually bring digital transformation in a dynamic environment (Kindermann *et al.*, 2020). As the need for environmental sustainability and maintaining environmental compliance

becomes necessary to compete in the rapidly changing environment, firms integrate, develop and reconfigure internal and external competencies centred around digital technologies, digital skills, digital infrastructure, and ecosystem(Chirumalla, 2021; Teece *et al.*, 1997). Further, competitors' launch of electric vehicles uses several advanced technology-based platforms to reduce carbon footprints and demand for better safety features intensify the need to build digital orientation. External pressure, created by competition, customer expectations, government regulations and environmental norms, brings rapid changes in the environment and drives organisations to develop digital orientation that helps them to nurture and implement specific digitalisation strategies and select appropriate digitalisation initiatives in innovation-based competition.

Similarly, dynamism, also known as the degree of instability of the marketplace, requires organisations to develop a digital orientation to reduce uncertainty present in the external environment and encourage coordination and information sharing. The dynamism of the external environment enables organisations to build a digital orientation to develop resilience by streamlining and improving processes and functions(Coskun-Setirek and Tanrikulu, 2021; Khin and Ho, 2019), making operations far more efficient, environment friendly, and less costly. Dynamism of the external environment also enables organisations to develop digital orientation so that digital technologies can be adopted to make objective, fact-based decisions to improve performance. Thus, this leads to the proposition:

Proposition 1a: Digital orientation of firms is largely dependent on the nature of external pressure encountered by the firms in the industry.

Proposition 1b: Digital orientation of firms is largely dependent on the dynamism of the marketplace in which firms compete.

Learning culture of organisations has the potential to change the behaviour of the workforce(Huber, 1991; Köhler, 1970). Firms that focus on the creation, acquisition and dissemination of knowledge and are able to modify behaviour to adopt new knowledge are more easily able to develop digital orientation in the dynamic environment. As digital orientation is a strategic orientation (Kindermann *et al.*, 2020) and requires the involvement of people, up-gradation of their knowledge, implementation of novel work practices, organisations stressing organisational learning culture are able to quickly acquire information and interpret it to fully understand its meaning and transform it to knowledge. Firms' inclination to engage in innovative activities and experiment with several digital technologies assist firms

in developing digital orientation. In this regard, commitment and support from leaders to overcome organisational inertia and include digitalisation around the centre of all its strategies become crucial for successful digital strategy. Leadership style also plays an essential role in building innovative and learning culture that encourages employees to learn how new systems(Škerlavaj *et al.*, 2010), processes, and practices work and experiment with novel digital technologies. Digital orientation of firms targets to fulfil higher-order needs. Therefore, transformative leadership in the context of digital orientation has been found essential as this form of leadership aims to seek higher-order needs of the followers. Transformation leaders are flexible, open to change, develop new visions, focus on long-term goals, inspire followers to follow higher-order goals, transform organisational culture and guide mentors to take responsibilities for the pursuit of organisational goals(Sony and Naik, 2019). Firms with more incredible innovations and learning cultures will most likely develop a digital orientation for adopting modern technology, skills and knowledge. Hence, this leads to the proposition:

Proposition 2a: The ability to develop digital orientation is largely dependent on the organisational learning culture in firms.

Proposition 2b: The ability to develop digital orientation largely depends on the innovative culture in firms.

Proposition 2c: Transformative leadership help firms in developing digital orientation.

The adoption of right set of digital technology largely depends on the knowledge management capability(Guisado-González *et al.*, 2017; Radosevic and Yoruk, 2018; Szalavetz, 2019). Knowledge plays a central role in a firm's learning process, characterised by acquisition, integration, and exploitation of knowledge (Cohen and Levinthal, 1990). The essence of knowledge management with respect to the adoption of digital technology is that it facilitates management in formulating an appropriate strategy for digital technology adoption. Grant (1997) suggested two distinct approaches for strategy formulation; where the first one relies on experience, intuition and interaction between thought and actions, whereas the second approach is based on a deliberate, rational and analytical process of a plan developed by upper management. In both approaches, management recognised the benefits of integrating knowledge management in strategy formulation. The potential of firms to develop an appropriate strategy for digital technology adoption depends on the prior accumulation of knowledge(McLoughlin *et al.*, 2019; Mubarak and Petraite, 2020b). Therefore, firms' potential to realise benefits from adopting digital technology is the by-product of investment in

knowledge and knowledge workers. Therefore, management needs to stimulate and improve knowledge of human capital, foster information sharing and communication to build, obtain and transfer knowledge.

Similarly, research & development (R&D) is an essential element that influences the adoption of digital technology in firms. It has been observed that firms that have a high level of digital orientation are mostly characterised by their excellent R&D activities. The focus of R&D is essential as it helps in the identification of appropriate technologies. Firms engage in experimentation to understand whether the latest digital technologies can be incorporated in their existing products or processes to improves their current product or processes or both. Investment in R&D also facilitates firms to imitate the best practices used by technological leaders (Aramonte and Carl, 2021). Extant literature also suggests that R&D plays a key role for firms willing to adopt the latest digital technologies. It helps in absorbing knowledge that is already present elsewhere and helps in undertaking frontier technology activities(Radosevic and Yoruk, 2018; Szalavetz, 2019). Hence this leads to the development of the following propositions:

Proposition 3a: The degree of adoption of digital technologies through digital orientation in firms is likely to be influenced by their knowledge management capability.

Proposition 3b: The degree of adoption of digital technologies through digital orientation in firms is likely to be influenced by their R&D investment capability.

Digital technologies, such as blockchain, internet of things, big data analytics, cloud computing, and additive manufacturing, help firms optimally use large amounts of data to engage in data-driven innovation through explorative and exploitative activities (Akter et al., 2019). From the efficient uses of resources to offer customised products and services, digital technologies suggest various decision options using both descriptive and predictive insights. Advanced digital systems based on artificial intelligence, machine learning, deep learning, neural network techniques suggest various decision alternatives (Su *et al.*, 2021; Tortora *et al.*, 2021) and their potential implications that can help firms engage in various explorative and exploitative activities to engage in data-driven innovation. Big data analytics, Internet of Things, blockchain and almost all the recent technologies provide a large amount of variety of data that can significantly influence innovation management(Guisado-González *et al.*, 2017). The diffusion of digital technologies has a more pervasive and ubiquitous impact on the firms' explorative and exploitative capability, which in turn offer opportunity for firms to engage in

digital innovation for providing new products, services, or processes. Hence, this leads to the following proposition:

Proposition 4: Motivated by the opportunity and benefit (data-driven insights) of novel digital technologies, firms will most likely invest in data-driven innovations through explorative and exploitative activities.

Implementing sophisticated digital technologies is insufficient if the workforce does not possess the required knowledge and skills and does not contribute to the right behaviours(Brunetti *et al.*, 2020; Khin and Ho, 2019). Teece *et al.*(1997) suggested that firms' resources, transformed by dynamic capabilities, include tangible, intangible, and human assets; it is obvious that novel human resource practices need to be developed to facilitate firms in their explorative and exploitative capability in bringing innovation. Decentralised decision-making, autonomy, greater access to information and decision-making rights positively influences both processes and products. Earlier studies also reported that advanced human resource practices such as flexible work assignments, self-directed work teams, regular information sharing, high-performance compensation practices, employee participation, and fair treatment are novel ways to encourage employees to adapt to changes and facilitate innovation management(Mishra, 2018). Similarly, the intentions and actions of organisations functioning in a dynamic environment to seize emerging opportunities also influence firm's ability to engage in the innovation process through digital technologies. As defined by Miller (1993, pp.771), "an entrepreneurial firm engages in product marketing innovation, undertakes somewhat risky ventures, and is first to come up with proactive innovations, beating competitors to the punch". Several studies also reported that entrepreneurial orientation in terms of processes, practices, and decision-making activities drives organisations to develop and deliver novel and innovative products or services that eventually help firms differentiate themselves from other firms (Naldi et al., 2007; Mishra and Mishra, 2018). Entrepreneurial orientation involves dimensions like innovativeness, risk-taking, proactiveness, autonomy and competitive aggressiveness that help firm to pursue pursuit of new market opportunities and the renewal of existing areas of operations" (Hult and Ketchen, 2001, p. 901). Therefore, entrepreneurial orientation can significantly influence data-driven innovation through developing explorative and exploitative capability using digital technology. Entrepreneurial firms explore and exploit necessary resources to build dynamic capabilities that enable them to create new products, innovate existing offerings or take essential actions to seize emerging

opportunities to address rapidly changing environments and face innovation-based competition. Hence this leads to the following proposition:

Proposition 5a: Data-driven innovation through explorative and exploitative capability in firms is positively affected by advanced human resource management practices employed in the firms operating in rapidly changing environments.

Proposition 5b: Data-driven innovation through explorative and exploitative capability in firms is positively affected by the entrepreneurial orientation of firms operating in rapidly changing environments.

Based on the empirical investigation, we have proposed a research framework as presented in Figure 3. The framework suggests that external pressure and dynamism present in the marketplace force organisations to develop digital orientation that in turn facilitates the adoption of digital technologies in firms. However, the development of digital orientation is enabled by the innovative and learning culture of the organisations, and the adoption of digital technologies is contingent on the ownership structure and size of the firm. Further, organisations develop explorative or exploitative capability, a type of dynamic capability, to improve innovation performance through data-driven insights generated by digital technologies. However, advanced human resource management and entrepreneurial orientation influence an organisation's explorative and exploitative capability to enhance innovation performance.

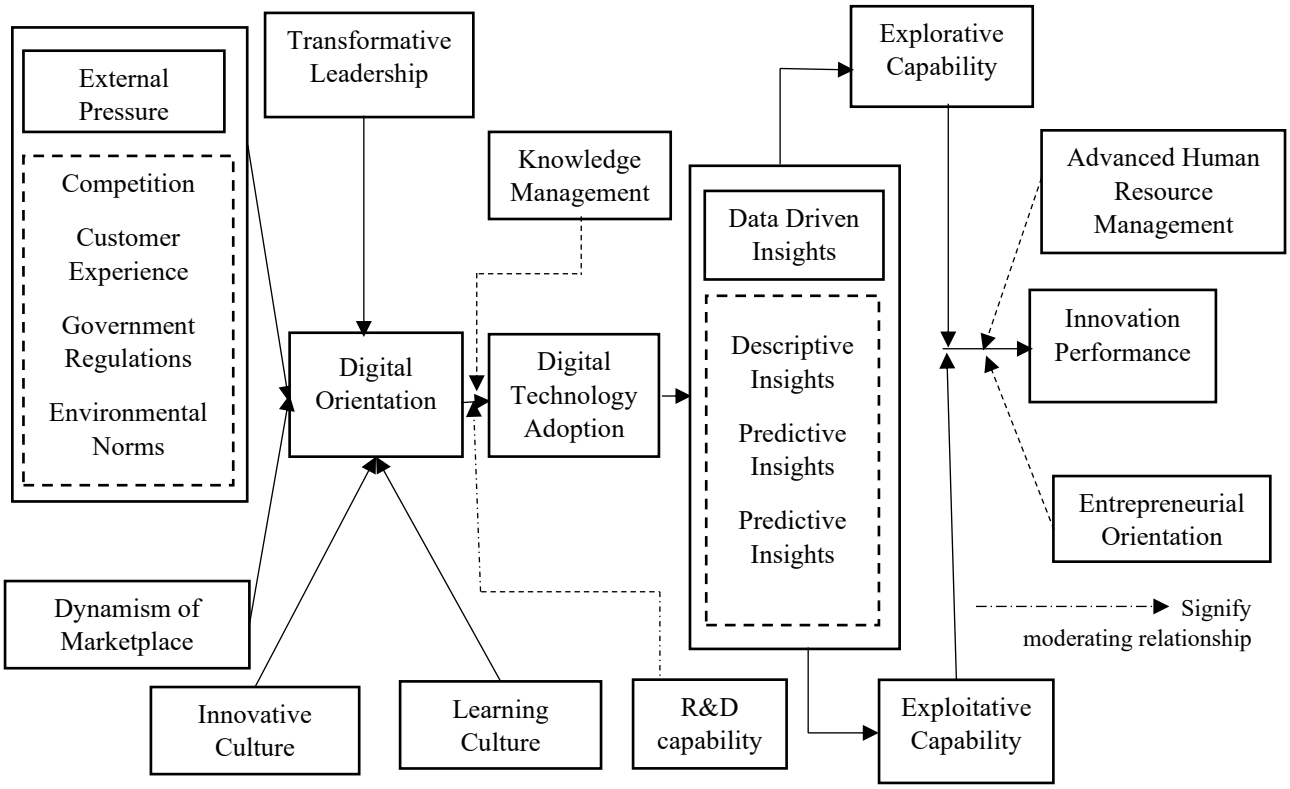

Figure 3: Proposed research framework for data driven innovations

5.1. Theoretical Implications

The study is explicitly grounded on the organisational learning theory and dynamic capability theory, which offers a practical foundation to explain the influence of external pressure and dynamism of the marketplace on building digital orientation, which facilitates learning through data-driven insights. Further, data-driven insights assist firms in developing dynamic capability (explorative and exploitative capability) that improve innovation performance. Therefore, the findings of the study can extend the existing body of knowledge of data-driven innovations in terms of understanding the role of external pressure, contingent variables and capabilities needed to improve the innovation performance. The present study may underpin future research to delineate the notion of data-driven insights and improvement of innovation performance in a pragmatic and holistic manner simultaneously, addressing rudimentary questions. Also, the findings would act as a basis for future survey-based empirical research in the domain of the digital supply chain.

5.2. Managerial Implications

The study proposes an integrated conceptual research framework to explain how an organisation can be engaged in data-driven innovations using organisational theory and dynamic capability theory within the SAP-LAP framework. The developed framework will assist practitioners in understanding the need for developing digital orientation and enablers of facilitating digital orientation, technology adoption, and innovation performance. It also helps to define the responsibilities of different actors in simplifying data-driven innovations. Data-driven innovations through the adoption of various digital technologies demand coherence between desired actions. The course of actions identified in the analysis will help in driving the transformation towards data-driven innovations.

This research offers important implications for practitioners and policymakers to develop and improve innovation performance in the automobile industry. The key managerial implications from the study are summarised as follows:

i. Create an organisational culture that focuses on learning and innovativeness. The significance of learning and innovativeness in developing digital orientation needs to

be realised by top management. Since digital orientation signifies a strategic orientation that caters to changes brought by digital technologies, organisation learning facilitates the development of digital orientation through efficient learning of their resources, competencies, and capabilities and take effective response needed in a dynamic environment. Learnings help to formulate and implement the strategy required to develop digital orientation. Similarly, organisations with innovative cultures get a better response from the environment and gain the capabilities needed to create digital orientation (Škerlavaj *et al.*, 2010). Therefore, top management needs to develop and improve organisational learning culture and innovation culture to create digital orientation.

ii. Practitioners need to develop advanced human resource practices for leveraging the capability required to improve innovation performance. It is equally important to have good management skills along with technical skills. Practices need to adopt advanced human resource practices, like selective staffing, training & development, high-performance compensation practices, regular information sharing, employee participation to improve knowledge transfer, productivity, and innovation. Practitioners have to work towards standardising the process, meeting the compliances and driving the transformation by training and educating employees for digital technologies. The employees need to upgrade their skill set and embrace the change, and that requires top-management commitment. Practitioners should view the concept of data-driven technologies from a holistic perspective and critically analyse the situation, actors, and processes involved in adopting digital technology.

iii. Build entrepreneurial orientation to encourage autonomy, innovativeness, risk-taking ability, proactiveness and competitive aggressiveness. It has been found that organisations with entrepreneurial orientation engage in innovation, undertake risky ventures and get a first-mover advantage while coming up with proactive innovation. Therefore, the potential of data-driven innovation can be leveraged through building entrepreneurial orientation with the firm.

6. Conclusion

Data-driven innovation is the heart of the automobile industry growth. Firms are applying a range of digital technologies, like IoT, computer vision, artificial intelligence, big-data

analytics, additive manufacturing in different functional areas such as research & development, engineering, manufacturing & operations, customer experience and mobility services to produce data-driven insights that help firms in nurturing explorative and exploitative capability and eventually improves innovation performance of firms in a dynamic environment. The study helped to develop a comprehensive understanding of how organisations develop data-driven innovation by developing digital orientation in organisations. With the advent of several data-driven innovative systems, the efficiency of operations and quality of production are being targeted for new levels of benchmark, which are way ahead of those of the traditional manufacturing systems. The descriptive case study of an automobile firm captured the salient features of digital technologies, the data-driven insights produced by them and their impact on innovation performance, thereby presenting a complete description of a phenomenon within its context(Eisenhardt and Graebner, 2007). In our attempt to understand this phenomenon, organisational learning theory and dynamic capability theory were applied within the SAP-LAP framework to investigate and analyse the case firm's actions and draw appropriate conclusions.

The study contributes to the digitalisation and innovation literature in the following ways:

i. It analyses a case firm's decision to implement digital technologies using organisational learning theory and dynamic capability theory within the SAP-LAP framework. Therefore, the study helps both researchers and practitioners to gain a better understanding of the above decision processes.
ii. It provides several research propositions that are developed from the case study. Though propositions are based upon an in-depth analysis of a single case study, the study can offer directions for appropriate research hypotheses for studying data-driven innovation across several manufacturing companies. The case study captures richness and details in the decision-making processes of an individual firm that other types of research methods cannot capture. Therefore, the study helps us to answers several "how" and "why" related questions about digitalisation.
iii. The study develops a research framework that can guide practitioners in making decisions when implementing digital technologies to foster data-driven innovation in their firms.

6.1. Limitations & Future Research

The study was carried out to see how digital technologies and data-driven insights produced by them affect innovation performance using organisational learning theory and dynamic capability theory within the SAP-LAP framework. The inherent benefits associated with data-driven insights delivered by digital technologies need to be seen from a long-term perspective. Further, subjective bias related to the data collection method in a case study can influence the findings of the study. Therefore, the findings of the case study can be substantiated with empirical research to overcome the biases. The results of the study are limited to the automobile industry, which can be extended to other sectors, or comparative studies can be conducted to examine sector-specific variables.

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