Digital Transformation (Dx), Impact on Transport Industry, Factors Driving Successful Implementation, Challenges faced - A study

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Abstract

Purpose : Digital transformation has become an essential trend in the business world in recent years. The quick developments in the area of information and communication technology has enabled organisations to prefer changes in their operations interact with customers and compete in the market. (Krenawidiansyah Agustin et al. 2023). The main motto of the present study is to explore about demographics and their impact on the study. Further, the study conducted to know the impact of digital transportation on consumer behaviour, factors driving successful implementation of digital transformation and challenges faced in the digital transformation. Digitalisation has been described as the 'Forth industrial Revolution" on account of its immense potential impact on consumers, societies and businesses.

Design of the study : A neatly drawn previously known questionnaire was administered in addition to Google Form via e-mail. Interviews held with customers by the researcher and participants gave cooperation by filling the Google form and sending. Relatively a small amount of sample was covered through Google form. The participants belongs to Bengaluru Urban and areas of study include Jayanagar, Indiranagar, Yelahanka, Malleswaram. MS Excel 16, chi-square, ANOVA, weighted average and Garrett ranking technique statistical told were performed.

Findings of the study: The study found the existence of significant variation among the demographic of respondents and with high degree of relationship. The impact of digital transformation on consumer behaviour reveals that acknowledging shifting consumer dynamics and gathers regularly feedback and deliver personalised services and understands feedback consumer mind and lays foundation for developing growth opportunities. The p-value is lower than significant level 0.05 and hence null hypotheses not accepted and reveals higher relationship with the variables. The study found that technology people and culture, rapid adoption of technology and mindset to open changes are the prime factors in the order driving successful implementation of digital transportation. The challenges of digital transportation include, digital divide, high cost of implementation and organisation hurdles.

Key words : High cost, digital divide, shifting, growth opportunity, consumer engagement, social media, interaction, urban, environment.

Introduction : The quick growth in urbanisation has lead the way for intensification of sustainability challenges in transport sector. These challenges include increasing energy demand, environmental degradation and rising carbon omissions (Vu, et al. 2024) and rising carbon emissions. Across the globe many companies as a response to the meeting of challenges are taking strategic steps by adopting technological advancement like transition to renewable energy sources and improvement in energy efficiency (Vu et al, 2024, W.U.H. Shah et al. 2024, Chicen, ES, 2024). Transport industry plays a central role in the economy by ensuring easy movement of goods and quickening social connectivity. At the scene time industry is facing challenges like environmental impact including green house gas emission, air pollution and the depletion of natural resources (Zhao, X-et al. 2026; Smith H. et al. 2022). Transport industry assures the criticalness in the hope of attaining rapid economic growth and urbanisation along with the facing of challenges of carbon pollution energy consumption and climate change (Componek, M. et al. 2022; Pieloch-Babiazz et al. 2021). International agreements like Paris Agreement on climate change (UN Frame work convention on climate change, 2015) along with (UN SDGS 2015) have exerted significant pressure on the transportation sector significantly and transportation enterprises must reduce green house gas emissions, transition to sustainable transportable models and improve energy efficiency (ASEAN Secretariat Transport Rapid Jakarta, 2021, World Bank. SDGS. Washington 2022; ADB Sustainable Transport Solutions for Southeast Asia 2019).

Information and communication Technologies (ICT) play a significant role in the transportation systems since they provide connection between transportation system, planners, operators and managers. (Georgian Scientists, 2004). Digital technology play a significant role in the development of road transportation which is guided by innovation and green strategies and is achieved through optimisation collaborated network structure enhancement etc. Digital Technologies possess the potential to fundamentally restrictive patterns of personal and goods movement thereby generating systematic impact on transport demand, spill over effects creation and reshaping the internet logistic development models of the road transportation system. Digital technologies are reshaping the transportation and logistics industry by leveraging emerging technologies to improve operational efficiency, enhance customer experiences, and stay competitive in globalised market (Wahya Khrniadi, 2025). Digital technologies is the use of digital technologies to improve transportation system and services, enhancing safety, efficiency and cost savings. Key trends include connected vehicles, autonomous vehicles, mobility as a service (MaaS), real time fleet management with telenasia i.e., telematics and the use of digital twins for infrastructure planning and maintenance. The transport industry was the first to feel the induction of digital technology. The objective behind such induction is to automate managements improve the reliability of the transport system, and to make the companies more competitive and then digitalise the entire sphere (Khabarov P. Volegzhania, 2018).

Statement of the problem :

The impact of digital transportation on digital transformation contains continuous improvements, challenges and new strategies influence its own future. The impactness is the study of a constant evolution forcing a focus on harmony element like skill, training and change management, along with technology to achieve sustainable competitive advantage. Digital transformation brings plenty of advantage and prime among them includes creates greater accuracy, brings optimisation of business process, reduction is operation cost and provides valuable insights into consumer

behaviour. The events of 2020 widened the value and revenue of digital transformation around the world and Bengaluru is not an exception. Economic and social constraints of corona virus pandemic have become a driver of transition to new business models, development of ecosystem platform and services and done technology. The growth rate for technology in India's transportation and logistics sector in sustained with the overall market exported to grown at compound annual growth rate (CAGR) is 10.7 until 2005 and the domestic express logistics segment growing even faster at 14%. A proper understand of the digital transformation on business and competitive advantage organisation can develop superior strategies to overcome these challenges. Digital transformation requires significant capital investment in technology infrastructure and training to attain sustainable success. The success of digital transformation depends upon implementation of strong employee training assumes significance. Since digital transformation can change how companies operate and internet with customers, potentially affecting the entire business model (Kresnawidiansyah Agusition et al. 2023).

Review of literature

The potential effect of digital transportation cannot be overlooked. Young et al (2022) demonstrated through the application of panel regression models and mediation effect analysis that the construction of digital cities significantly reduce carbon intensity and intervenes in carbon emissions through three pathways, technological innovation, industrial structure adjustment and energy structure optimisation.

The research by Maetal (2023) further validates that the level of urban digital development effectively enhances energy savings and emission reduction performance.

The research by Wahya Kurniadi. (2025) reveals data about the impact of digital transformation on the transportation and logistics sector in Indonesia, focusing on key technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), blockchain, and cloud computing. The adoption of these technologies as per the researcher has led to real-time tracking data driven decision making and improved supply chain integration. But the challenges like high initial investment, a lack of digital expertise, and cyber security concerns remain significant barriers to widespread adoption. Using a qualitative descriptive approach, the research work examines various case studies and literature to highlight how Indonesian companies are implementing digital solutions and the resulting benefits and obstacles. The result of the study highlight while digital transformation offers substantial planning investment in workforce development and strong industry partnership.

Chien, F.S. et al (2024) stated that in order to cope with environmental issues countries have adopted different measures out of which technological advancement and green finance are gaming importance. The study aims at estimating the effect of technological advancements and green house on environmental substantiality measured by ecological foot prints under Stochastic Impacts by Regression on Population, Affluence and Technology (STIRPAT) models in Indonesia. Data collected for the period 1995-2020 and data collected from different secondary sources and empirical analysis performed by applying quantitative Autoregressive Distributed Lag Model. The findings reveal the positive contribution of technological advancement measured Information and communication Technologies, and green finance in environment sustainability. The researchers

suggested that the Indonesian Government to pay attention to critical fruitful policies aimed and promotion of green finance ICT to ensure environmental sustainability.

The researchers Nataliya A. Mashkina. (2021) reveals the nature and mechanisms of the influence of the digital economy on the development of the transport industry in the world. The essentials for researching the problems of digitalisation in the transport sector are decided by several factors of using latest technological achievements which derives competitiveness of transport companies. The researcher used scientific abstraction analysis of facts and observation of the real existing picture. The researchers identified the key components of the digitalisation process and recognised those that have the greatest impact on the transport sector. The research reveal about existing experience of transport digitalisation the consequences of this process. The main result of the study was the conclusion that the objective need of the transport industry for new innovative developments is very high.

Daniele Shilino. (2024) stated that digital transformation is not just about technology, but also about people, their mindset. The research work aims to address the fundamental question about factors that impact organisations, and factors responsible for failure of digital transformation. The research work by the researchers highlight that digital transformation centers around the use of technology which has a significant impact and brings changes in the organisation, people and culture. Further, the researcher opined that the specific implications may vary depending on the industry, organisation size and scope of the transformation effect. The study suggests that a clear strategy, the capability to foster innovation and a ability to redesign the business model, reliance on data driven decision making, a mindset to open change and the creation of a culture that promotes experimentation, continuous learning and adaptability are the successful factors for digital transformation.

Research Methodology

Data Source : The present study considered both the sours of data i.e., primary and secondary data. Primary data gathered by administration of pre-planned and previously known questionnaire and also through Google Form. Questionnaire was administered as schedule since the respondents covered was 75 and to avoid rejection, incompleteness. 25 respondents data gathered through Google form and interview with them was held. All the respondents gave maximum cooperation and the data was collected properly. The secondary sources include books, journals and internet.

Sample and sampling technique : One hundred sample was considered for this study. Using convenient sampling technique interview was conducted.

Coverage of the study : The study intentionally selected the areas of Bangalore Urban like, Jayanagar, Indiranagar, yelahanka and Malleswaram. 25 respondents each covered in these areas including Google form.

Data Analysis : The data was analysed using the quantitative techniques like ANOVA, MS Excel 16, Chi-square contingency co-efficient, weighted Arithmetic mean and Garrette Ranking Technique Likert 3 point scale also performed while recording the opinion of respondents.

Respondents covered : Respondents from the different areas were selected and interview with them conducted. These personal include government employees, private employees, business people professional persons, retired and home makers.

Objectives of the study

1. To study the socio-economic characteristic of respondents.
2. To study the impact of digital transformation in consumer behaviour.
3. To analyse factors driving successful implementation of digital transformation.
4. To analyse the challenges of digital transformation.

Hypotheses

H_{01} : There is no significant variation in the demographics of respondents and hence do not impact on the study.

H_{02} : There is no effect of digital transformation on consumers behaviours.

H_{03} : Factors are not driving successful implementation of digital transformation.

H_{04} : Digital transformation do not face challenges.

Research questions

1. What are the reasons behind for the demographics not impacting on the study?
2. What is the impact of digital transformation on consumers behaviour?
3. What factors drives the successful implementation of digital transformation?
4. What are the challenges of digital transformation?

Limitations

1. The study is confined to Bengaluru Urban selected areas only.
2. The sample covered is small and may not cover all the respondents.
3. The problem of time, finance and transportation felt very badly.

Survey Findings

Table-1 divulge data about socio-economic characteristics of respondents. There are 80 males and 20 females and out of 100, 81 are married, 11 single and 8 divorcees. Age data reveals that 42 pertain to the age group of 40 -50 years. 27 to be 30 - 40 years, 9 to the 60 - 70 years group, 10 against 40-50 years. The education data reveals that 46 are degree holders, 22 post graduates, 15 completed PUC, 9 professional degree holders and 8 studied upto 10th standard. Occupation data reveals that there are 40 private employees each 18 doing business and government employees, retired 10 and homemakers 05. Monthly income data reveals that 40 are getting a monthly income in the range 60-80, 22 in between 80-100, 12 respondents income monthly income fell between 4060K, 10 in between 100-120K, and each in between 20-40K and goes in between 20-40K, 8

each getting > 120K, and 8 more getting on between 20-40K. Further, the table also reveals that 43 are living in developing areas and 2.9 in developed and 8 living in outskirts. All the socio economic characteristics showing significant variaion with high degree of relationship.

Table-2 reveals data regarding, impact of digital transformation on consumer behaviour to measure the same ANOVA quantitative technique performed. The opinions of respondents presented by means Likert 3 point scale. Opinions of the respondents recorded by using the scale points varying from 'strongly agree to somewhat agree'. Accounting 77 expressed SA, 14 57 and 4 SWA. 35 being the highest strength of respondents preferred acknowledging shifting consumer dynamics, 17 liked gathers regularly feedback and deliver personalised services and 11 each understands the consumer mind about seamless digital interactions and lays foundation for developing growth opportunities. P-value being 0.00213 < significance level 0.05 rejects the null hypotheses and thereby we can conclude that there exist high degree of relationship between the variables.

Table-3 highlights data about factors, driving successful implementation of digital transformation. To measure the successfulness weighted arithmetic mean was performed. The opinions are termed as "f" and the weights are defined as "w". The sum of "w" to obtain "WA". Based on the order of highestness of WA ranking was performed. Accordingly the first rank was awarded to technology, people and culture, the second rank to rapid adoption of technology and the third rank was awarded to mindset to open changes. The remaining factors are ranked as per their highestness.

Table - 4 and 5 reveal data about challenges of digital transformation and per cent position and Garrett values. There are considered challenges and opinions are placed as per their insistence. The mean score was computed dividing total score by number of respondents and based on the order of ranks ranking was performed. Accordingly the first rank was awarded to digital divide challenge, the second rank to the highest cost of implementation and the third rank to the organisation hurdles. The calculated values are referred in the Garret percent position table to record current values. These current values are the observation which is referred as 'f' and per cent position Garrett values and fx obtained(Table - 5).

Survey Discussion:

The main intention of the present study is to study how far the demographics impact on the study. Further, the study also undertaken to study the impact of digital transformation on consumer behaviour and the study also concentrated on the factors driving successful implementation of digital transformation. Furthermore the study also conducted to probe the challenges of digital transformation. The socio economic characteristics of Bengaluru Urban respondents significantly varying with high degree of relationship. Further the impact of digital transformation is seen in the form of acknowledging shifting consumer demand, gathers regularly feedback and deliver, and understands the consumer mind about seamless digital interactions and lays foundation for developing growth opportunity. Further, the study found that factors like technology, people and culture, rapid adoption of technology and mindset open to changes which are called as successful drivers of implementation of Dx. The challenges that are probed includes digital divide, high cost of implementation and organisation hurdles. Bengaluru respondents already showing their concern for digital transformation by the companies. Global famous silicon valley and now nicknamed as 'science city' likes any innovative changes in digital transformation. They exhibit high levels of

confidence and positive attitudes towards digital transformation with business leaders in the Bengaluru urban being particularly optimistic about their local digital environment.

Conclusion :

The gist of the study is well highlighted in the form of that digital transformation is a complex with broad and deep economic and organisational implications. First the paper highlighted that demographics impacting positively on the study, secondly the study aimed to studying the impact of digital transformation on consumers behaviour which includes acknowledging shifting consumer dynamics, gathers regularly feedback, and delivery personalised services. The driving factors of successful implementation of digital transformation include in the order, technology, people and culture, rapid adoption of technology and mindset to open changes. Further, the study also probed about the challenges faced which include digital divide, high cost of implementation and organisation hurdles. The study suggest the need of capability to foster innovation and agility, the ability to redesign the business model, rely upon data driven decision making. The specific implementation of digital transformation may vary one to other industry, organisation size and the scope of the transformation effort.

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Table - 1 :Demographic of respondents

Demographics	x^2	TV @ 0.05	df	Result of x^2	"c"	Result of c
Gender	36.00	3.841	1	Significant	0.51	High Degree
Marital status	102.92	5.991	2	Significant	0.71	High Degree
Age in years	64.7652	11.070	5	Significant	0.62	High Degree
Education	48.50	9.488	4	Significant	0.57	High Degree
Occupation	47.488	11.070	5	Significant	0.56	High Degree
Monthly income (INR)	47.2949	11.070	5	Significant	0.57	High Degree
Living area	46.2245	5.991	2	Significant	0.56	High Degree

Source: Field Survey
Note : x^2 = Chi-square
'c' = $\sqrt{(x2 / x2 + N)}$
Where 'c' = Contingency Co-efficient, N = Number of Observations
When the value 'c' is equal or nearer to 1, it means that there is high degree of association between attributes. Contingency co-efficient will always to be less than 1. High degree is considered here if 'c' is 0.50 and above.

Table-2 : Impact of Digital Transportation on consumer behaviour

No.	Impactness	SA	A	SWA	T
1	Acknowledging shifting consumer dynamics	24	7	4	35
2	Understands the consumer mind about seamless digital interactions	9	1	1	11
3	Establishes closer connections with customers	7	1	-	8
4	Leveraging social media, various digital platforms understands consumer dealing	8	1	1	10
5	Gathers regularly feedback and delivery personalised services	13	2	2	17
6	Lays foundation for developing growth opportunities	9	1	1	11
7	Fosters customer engagement and loyalty drivers the expansion of business endeavours	7	1	-	8
	Total	77	14	9	100

Source : Field Survey and Google form

ANOVA
Summary

Groups	Count	Sum	Average	Variation
Column - 1	7	77	11.0000	37
Column - 2	7	14	2.0000	5
Column - 3	7	9	1.285714	1.904762

ANOVA

Source of variation	SS	df	MS	F	P-value	F-script
Between the groups	410.381	2	205.1905	14.02061	0.000213	3.554557
Within groups	263.4286	18	14.63492			
Total	673.8096	20				

Source : Field Survey & Google Form

ANOVA Analysis

The above table shows that the p-value being 0.000213 less than the significance level 0.05 and ANOVA fail to accept H_0. There is a strong evidence that the observed effect is real and not just due to random chance. Further, a big F-value and small P-value means null hypotheses is discredited and it can be concluded there exist a significant variation in the data.

Table - 3 : Factors driving successful implementation of Digital Transformation

Factors driving of successful implementation of digital transformation	Weight	3	2	1	T	WA
	Likert Scale	SA	A	SWA		
Digital Technology	f	84	13	3	100	VI
	fw	252	26	3	281	46.83
Organisation and manufacturing system	f	75	14	11	100	XIV
	fw	225	28	11	264	44.00
Customer expectation behaviour	f	76	14	10	100	XII
	fw	228	28	10	266	44.33
Business Models	f	68	14	18	100	XVIII
	fw	204	28	18	250	41.67
Operational transaction efficiency	f	67	18	15	100	XVII
	fw	201	36	15	252	42.00
Innovation technologies - AI, ML, Cloud computing, IoT, 3D printing etc.	f	78	15	7	100	IX
	fw	234	30	7	271	45.17
Creation of digital platforms	f	76	13	11	100	XIII
	fw	228	26	11	265	44.17
Use of digital networks	f	78	14	8	100	IX
	fw	228	26	11	265	44.17
Digitally aware business strategies	f	79	15	6	100	VII
	fw	237	30	6	273	45.50
Adoption of multi stake holder perspective	f	78	13	9	100	XI
	fw	234	26	9	269	44.83
Greater customer interaction	f	79	15	6	100	VII
	fw	237	30	6	273	45.50
Technology, people and culture	f	97	3	-	100	I
	fw	291	6		297	49.5

Digital technology, digital competition and digital customer behaviour	f	90	8	2	100	IV
	fw	270	16	2	288	48.00
Rapid adoption of technology	f	94	4	2	100	II
	fw	282	8	2	292	48.67
Capacity to foster innovation and agility	f	90	5	5	100	V
	fw	270	10	5	285	47.50
Reliance on data driven, decision making	f	68	19	13	100	XVI
	fw	204	38	13	255	42.50
Mindset to open changes	f	92	6	2	100	III
	fw	276	12	2	290	48.33
Continuous learning and adaptability	f	69	23	8	100	XV
	fw	207	46	8	261	43.50

Source : Field Survey
Likert scale : 3 Point - SA - Strongly Agree, A - Agree, SWA - Somewhat Agree
Weights = 3 + 2 + 1 = 6
WA = fw total / sum of weights = Σfw / ΣW

Table - 4 : Challenges of Digital transformation

Scale and scale value of ranks												T	MS	R
Different challenges	Scale	I	II	III	IV	V	VI	VII	VIII	IX	X			
	Values-x	82	70	63	57	52	47	42	36	29	18			
Digital Divide	f	35	16	11	9	6	5	4	5	4	5	100		
	fx	2870	1120	1050	513	312	235	168	180	126	90	6654	66.54	I
Organisational hurdles	f	29	15	11	14	10	7	6	5	2	1	100		
	fx	2378	1050	693	798	520	329	252	180	58	18	6276	62.76	III
High cost of implementation	f	38	19	10	9	5	3	2	3	4	7	100		
	fx	3116	1330	630	513	260	141	84	108	116	126	6424	64.24	II
Cyber security and data privacy	f	26	15	12	18	6	5	4	6	4	4	100		
	fx	2132	1050	756	1026	312	235	168	216	116	72	6083	60.83	IX
Slow internet speed	f	30	15	12	13	6	5	5	6	5	3	100		
	fx	2460	1050	756	741	312	235	210	216	145	54	6179	61.79	V
Job displacement	f	29	16	13	12	7	5	3	5	6	4	100		
	fx	2378	1120	819	684	364	235	126	180	174	72	6152	61.52	VI
Managing large data set	f	28	14	18	11	8	6	2	4	5	4	100		
	fx	2296	980	1134	627	416	282	84	144	145	72	6180	61.80	IV
Challenge of regular training the employees	f	26	13	15	12	10	8	6	3	3	4	100		
	fx	2132	910	945	684	520	376	252	108	87	72	6086	60.86	VIII
	f	27	15	10	13	10	7	6	6	4	2	100		

Environment impact - Electronic waste	fx	2214	1050	630	741	520	329	252	216	116	36	6104	61.04	VII
Adaption by small businesses	f	23	10	14	12	9	8	4	8	7	8	100		
	fx	1886	700	882	684	468	376	168	288	203	90	5745	57.45	X

Source : Field survey and Google form.
Note : Means score = Total score / No. of respondents

Table - 5 : Per cent position and Garrett values

Scale	100 (R_{IJ} - 0.5) / N_J	Calculated value	Current value
1	100(1 - 0.5) / 10	5.00	82
2	100(2 - 0.5) / 10	15.00	70
3	100(3 - 0.5) / 10	25.00	63
4	100(4 - 0.5) / 10	35.00	57
5	100(5 - 0.5) / 10	45.00	52
6	100(6 - 0.5) / 10	55.00	47
7	100(7 - 0.5) / 10	65.00	42
8	100(8 - 0.5) / 10	75.00	36
9	100(9 - 0.5) / 10	85.00	29
10	100(10 - 0.5) / 10	95.00	18

Source : (1) Subhash Vagale (2016). Village consumer behaviour towards permissible goods. A study w.r.t. Ahmednagar district of Maharastra, Pezzottaite Journals, 5(3), 2286-2287.
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