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# Assessing the Impact of Integrated Information Systems on Operational Efficiency in Indian Salon SMEs

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**Abstract:** Over 80% of small and medium salons in India still depends on the manual ledgers and the excel sheets for billing and appointment scheduling. This leads to problems such as delays in the business operations, inaccurate GST filing and lack of visibility regarding the staff performance (FICCI, 2023). This paper presents TASA (The All-in-one Salon Assistant) a lightweight, GST compliant system. This digital system designed specifically for Indian SMEs especially for those business in the beauty industry. Qualitative field surveys along with quantitative statistical analyses were done using Python programming language. These methods helped to understand the operational challenges and it helped to validate the proposed system. Survey results from 265 participants which includes feedback from the owners, staff, managers, and consumers. The findings reveal significant operational inefficiencies especially in billing, appointment scheduling, staff performance tracking and filing GST compliance. Experimental results showed remarkable results such as 50 to 60% of the billing time is reduced. Many feel easy to file for GST hence its accuracy increased by 98%. Approximately issues in appointment booking is reduced by 80% and 60 to 70% of less no shows happened that is there are more repetitive customers. This study contributes to information systems and e-business researches. It provides empirical evidence on how integrated digital platforms enhance managerial decision making, operational transparency and service efficiency in emerging economy SMEs.

**Keywords:** Information systems; E-Business; Appointment Scheduling; GST Compliance; Small and Medium Enterprises (SMEs); Digital Transformation; Multi Tenant Architecture.

## I. INTRODUCTION

The Indian beauty and wellness is a ₹20,000 crore industry. It is one of the most dynamic service sectors in the country (FICCI, 2023). Salons have become a major part in the lifestyle of the people starts from metropolitan cities to towns and villages. Everyone wants to get groomed. Salon offers all kinds of services start from basic grooming to advanced treatments. These trends shows that as there is a digital growth which increases the awareness about the personal grooming among the people (KPMG, 2022). Still most of the small and medium salons in India depends on the outdated systems such as handwritten ledgers and excel spreadsheets (World Bank, 2021). There are several drawbacks in the traditional methods such as fragmented billing and poor GST compliance. In addition to that tracking the staff performance is also very difficult and customer engagement is very limited (FICCI, 2023). This is an industry which runs based on the repeated customers and the quality of the service. Hence the lack of a proper and integrated digital environment leads to challenges and inefficiencies in the operation of the business. It also limits both growth and the profits. Most of the small and medium salons owners have no idea about how their business is performing. Without any proper data, the salon owners struggle to make decisions about staffing, promotions and also about investments. Mostly these decisions are based on the intuition of the owners rather than facts (Verma & Joshi, 2021).

Appointment scheduling is also an another tough tasks. Staff often double book clients because of manual appointments. This leads to confusion and leaves many empty slots unoccupied. Because of double book, customers also get irritated and cancel the appointments. It leads to the negative feedback (Kumar & Singh, 2022). Research shows that scheduling the appointments digitally will improve the customer satisfaction significantly. It will also reduce the customer wait time and this will definitely leads to increase in the client retention (Ali & Prakash, 2019).

Lack of proper salon records leads to difficulty in managing the business insights for salon owners. Absence of dashboards and reporting tools make it even more difficult for the salon owners to analyze the performance of the salon. The statistics such as most revenue generating services, employees who have higher customer satisfaction rate and income vs expense are important to evaluate the performance of the salon (Lee & Kim, 2020). These are considered as blind spots and these may leads to stagnation.

Maintaining and filing GST compliance is a huge task. Even the SMEs including salons are required to maintain proper tax records. Filing the GST returns on time is still a nightmare. Manual billing and poor record keeping makes the filing even more difficult. Small errors may lead to huge penalties. This will in turn create financial stress and reputational damage (Kumar & Singh, 2022). In order to avoid all these, big enterprises often invest in expensive ERP softwares or in any other digital accounting systems. But it is either costly or complex. So most of the small salon owners feel difficult to use it (Sharma & Gupta, 2021).

Rise of digital platforms have increased the customers expectations. Customers expect convenience in almost all services starts from food delivery till e-commerce. They expect instant updates and reminders via WhatsApp or SMS. Ease of appointment booking plays a crucial role in attracting customers in this sector. Integrating such things along with the digital payments attract more customers (KPMG, 2022). Unfortunately, the existing salon management tools are designed for Western markets. It fails to meet the needs of the Indian businesses (Verma & Joshi, 2021).

To address these gaps, the TASA (The All-in-one Salon Assistant) system has been developed as a comprehensive digital platform. This is developed in order to satisfy the needs of Indian salons. TASA directly addresses challenges such as fragmented billing and lack of staff accountability. It also helps to resolve the issues related to GST filing and customer engagement. The main concept of TASA is to create a simple and affordable software for all needs. It has been designed to empower the salon owners to manage their business effectively even with the limited technical knowledge (Lee & Kim, 2020).

TASA consolidates the essential workflows into a single platform. It includes appointment scheduling, staff linked billing and incentive tracking. It also includes daily expense logging and real time interactive dashboards (Verma & Joshi, 2021). This system reduces error and saves time by automating the billing and GST compliance. TASA creates the transparency in the performance measurement and in the incentive calculation by linking the bills directly to the corresponding staff members. Attrition rate is a major concern in the beauty industry. Research shows that the transparent incentive structure increases the accountability of the staffs and also reduces the attrition rate (Lee & Kim, 2020).

For appointment reminders and updates TASA uses WhatsApp and SMS platforms. This will increase the customer engagement. Existing tools rely on email notifications for the reminders which will not work in India. Because in India the communication medium is dominated by WhatsApp and SMS platforms. This unique feature expected to increase the customer retention and also increase the business profits (KPMG, 2022).

World Bank (2021) in its studies highlighted that the digital adoption will affect the growth of the SMEs in a positive way. TASA helps SMEs to attain the financial inclusion and also long term sustainability. TASA strengthens the Indian SMEs by providing this digital platform.

Research by Verma & Joshi (2021) points out that SMEs in India face adoption challenges such as cost, lack of digital literacy and fear of complex technology. Therefore TASA focuses on creating a user friendly and affordable subscription models. It creates an app with a simplified user interface. TASA does not require much knowledge to use it. So it creates confidence among first time digital users.

To summarize, growing demands and increase in customer expectations creates lots of opportunities to grow but outdated manual practices limit efficiencies and reduce the trust among the public. TASA is designed to act as a bridge between these two realities. TASA provides a simple and affordable digital solution. TASA empowers the small businesses to break this digital divide by combining automation, compliance and customer engagement.

## II. RESEARCH OBJECTIVE AND CONTRIBUTIONS

The main objective of this study is to understand and evaluate how operational and managerial inefficiencies can be addressed by the integrated digital information system. These challenges are still exist in service oriented SMEs. The study focuses on:

- 1) Examine the impact of manual operations in efficiency, compliance filing and staff accountability especially in Indian salons.
- 2) Design a lightweight digital platform which supports billing, incentives and customer communication.
- 3) Assess the system with the help of field surveys and quantitative validations in order to understand the operational and managerial impact.

This paper contributes to the literature on information systems and e-business. It provides empirical evidence of digital transformation outcomes. It also shows how integrated information systems results in enhanced visibility and provide better outcomes. Mainly, It offers practical insights for developing affordable and scalable environment.

### III. LITERATURE REVIEW

The Indian Beauty & Wellness Industry Report by FICCI (2023) states that even though the beauty sector is valued at more than ₹20,000 crore, 80% of the salons still remains unorganised. This report highlighted the billing inefficiencies and the lack of staff performance tracking. TASA helps to bridge these gaps between the systems with a transparent and efficient model.

Lee and Kim (2020) highlighted the importance of modular design and micro services architecture in order to attain the scalability in the design. They pointed out that the building software should grow along with the business needs dynamically. This is the most relevant factor when comes to the salon industry. And also they mentioned that the model should be accessible by everyone. TASA built based on these inputs, in order to make it affordable to every SMEs.

The work of Sharma and Gupta (2021) pointed out about the ERP models. They stated how this ERP model increases the efficiency of the business. The existing ERP models are either too costly or too complex. TASA integrates all the features starts from appointment booking till GST compliance filing. TASA overcomes the complexity of traditional ERP models. TASA makes everything easier and simpler compared to the traditional ERP models.

Kumar and Singh (2022) proposed the blockchain based framework for GST compliance filing. This will ensure the security and privacy of the salon owners. TASA implemented this in order to attain the immutable and safe transactions. Most importantly TASA implemented this in a simple way in order to increase the accessibility among the SMEs.

Ali and Prakash (2019) focused on the appointment scheduling algorithms. They highlighted the importance of digital appointment scheduling softwares and its impact on the efficiency of the business. TASA implemented this appointment booking module. This will save lots of time and stop from double bookings and reduces free slots.

The study by Verma and Joshi (2021) analyzed the existing barriers. Shifting SMEs from traditional manual booking module to digital is not that easy. There are lots of challenges such as high cost, digital literacy and lack of localisation. TASA's vision is to eliminate this digital divide and make it accessible to everyone.

The World Bank (2021) highlights the importance of digital world in the growing economy. It points that digital transformation is no longer an option. It is mandatory in order to cope up with the competition. TASA is built by keeping this in mind. TASA implements all the needed features digitally and the features are tailored based on the local needs.

KPMG's (2022) report highlighted about the changing mindset of the customers. It pointed out the increased expectations of the customers. TASA seeks to full fill these expectations by dynamically incorporating the current needs of the customer. TASA focus on the needs of salon owners as well. It bridges the gap and maintains the balance between the needs of both customers and salon owners.

### IV. METHODOLOGY

This paper combines both the qualitative and quantitative methods in order to understand the workflows of the salon industry and also to validate the proposed TASA system.

#### A. Problem Identification

A field surveys and semi structured interviews were conducted across Chennai. Salon owners, managers and customers were participated in this. In order to understand the problems faced by the salon businesses and identify the expectations of the customers this surveys were conducted.

Findings from Surveys and Interviews:

- 1) **Billing Inefficiencies:** Over 79% of salon owners reported that even now they are doing the manual billing and through basic excel sheets. They face problems such as errors in tax calculation, incorrect service charges and loss of handwritten bills. One salon owner said: *"During peak hours, we mostly skip the details. We focused on getting the work done than the accuracy. Later it becomes a problem when filing GST."*
- 2) **GST Compliance Challenges:** Around 68% of participants highlighted the difficulties in GST filing. They depend on the accountants in order to do the GST filings. This is costlier and also if they forgot to do so, it will leads to penalties (Kumar & Singh, 2022).
- 3) **Appointment Scheduling Issues:** Nearly 60% of staff members interviewed admitted the fact that they either double book the clients or leave the free slots unbooked. Ali & Prakash (2019) also highlighted about this in their work and emphasised the importance of digital appointment booking systems.

- 4) Staff Performance & Incentive Tracking: Out of 15 salon managers, 65% of them said that staff linked performance tracking is not there. Incentives are either manually calculated or skipped. This leads to disputes and attrition. As one stylist explained: “We feel our works are not recorded properly. Incentives are given randomly.”
- 5) Customer Engagement Gaps: A feedback from the customers were collected from over 50 salons, in this 80% of them preferred WhatsApp reminders for appointments and offers. But still most salons rely on calls for reminders. Customers often feel annoyed.

These findings confirm that the manual operations were inefficient. Profitability and customer retentions were also reduced. Existing salon software are too expensive for SMEs. It fails to adapt to the Indian workflows (Verma & Joshi, 2021). Therefore, it is evident that there is a need for digital compliance software which is efficient, affordable and easily accessible.

### B. Statistical Survey

A field surveys and semi structured interviews with salon owners, managers, staff and customers were conducted across Chennai. The questionnaires for the survey was designed about the four key domains of operation such as billing practices, GST compliance, appointment scheduling and staff incentive management. A consumer side survey was also carried out in order to understand the preferences of the customer.

A total of 100 salon owners, 100 staff members, 15 managers and 50 consumers were participated in this survey. Responses were converted into proportional indicators. Binomial confidence intervals at the 95% level were calculated for each indicators. This approach is widely used in small samples for estimating prevalence with greater accuracy (Sharma & Gupta, 2021).

The results are represented through bar charts with 95% confidence intervals. The bar chart highlights the operational inefficiencies. A donut chart illustrates the consumer preferences for WhatsApp reminders. A summary table was drawn for each indicators such as sample size, point estimate and confidence interval for each indicator. Such visualizations makes the comparison across operational areas easier (Ali & Prakash, 2019 and KPMG, 2022).

The below mentioned Figure 1 highlighted the survey findings. It reveals that 79% of salon owners relied on manual and excel based billing even now. 68% face difficulties in GST filing. 60% of staff faces issues with appointment scheduling and 65% of managers confirm that performance linked incentives are not tracked.

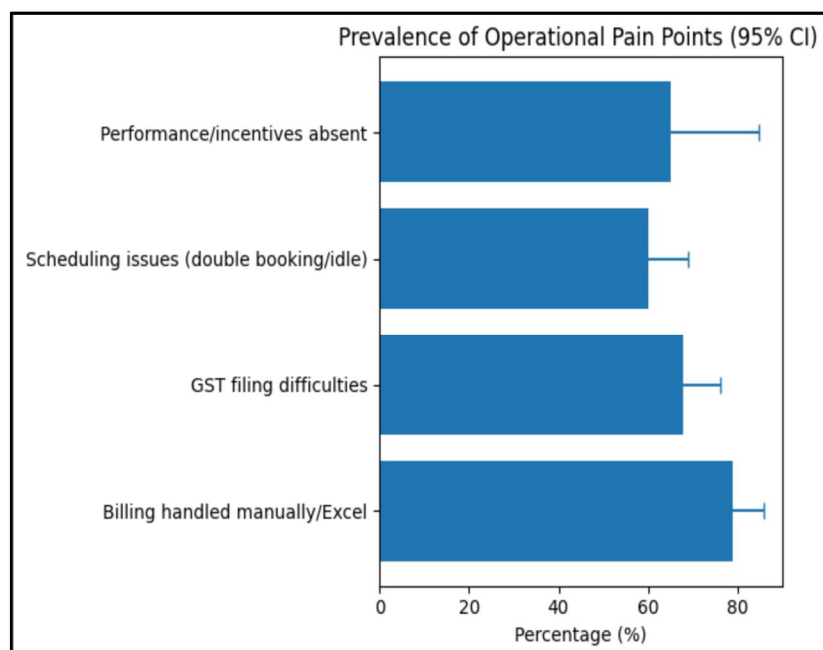


Figure 1: Prevalence of operational pain points among surveyed salons in Chennai (95% Wilson CI)

The Figure 2 mentioned below highlighted the survey report on the consumer side. It points out 80% prefer WhatsApp reminders over calls. This chart is obtained through a python program which is added in the Appendix A.

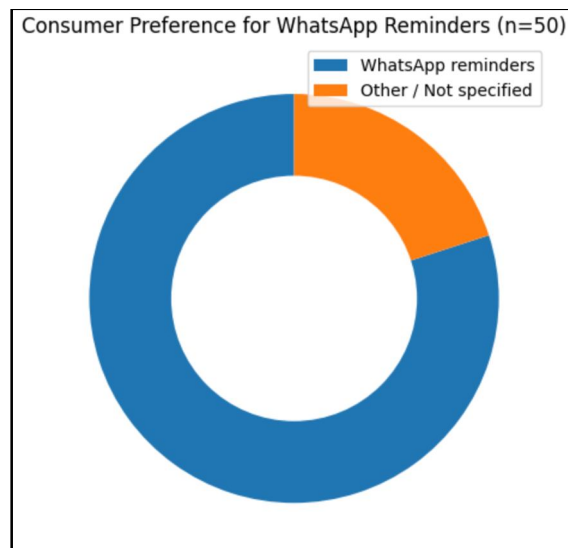


Figure 2: Consumer preference for WhatsApp reminders (n=50)

The below obtained Figure 3 highlighted the issues of appointment booking and scheduling. It is noted that 60% of the staffs still face appointment scheduling issues. They either double book or leave the slots idle. The statistical formula to calculate this Wilson score is added in the Appendix B.

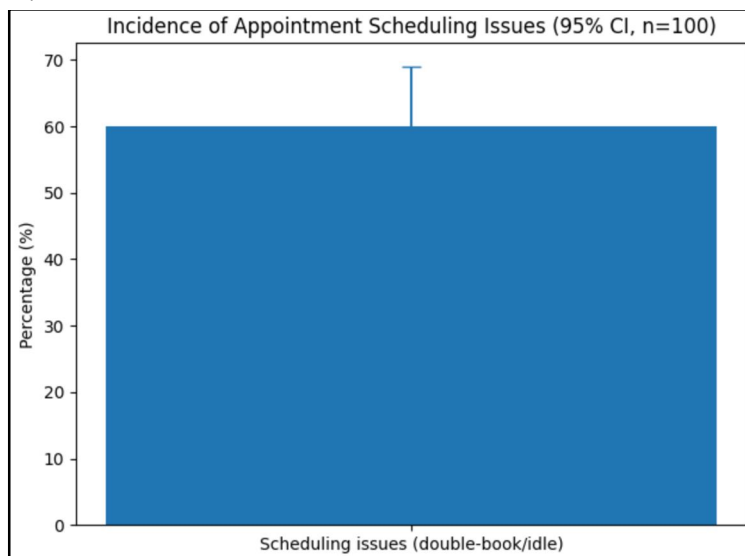


Figure 3: Incidence of appointment scheduling issues among staff interviews (95% CI)

These results confirm that manual practices are still prevalent and it create inefficiencies. This inefficiencies directly impacting the profit of the business and also the customer retention.

### C. System Design

From an information systems perspective, the design of TASA focuses on process integration and managerial visibility rather than technical sophistication. Each module is mapped directly to a core business function. This mapping is done in order to support the operational control and decision making for SME owners.

TASA is built as a single application using monolithic architecture. All features are combined into one unified system. The features such as appointments, billing, staff incentives, expenses and reports are all grouped separately and put together in a single system. Each module in TASA is designed in order to solve the real world problems. The appointment module prevents double booking and suggests available slots.

It also sends reminders to the customer a day prior to their appointment (Ali & Prakash, 2019). The billing module automatically applies GST rules and makes it easy to file for the GST compliance (Kumar & Singh, 2022). The incentive module calculates bonuses transparently based on staff performance. This transparent structure motivates the staffs to do better job. The expense module records spending such as rent, consumables and utilities. The reporting module consolidates data into simple dashboards. These dashboards allow owners to see sales trends, staff performance, and expense-to-revenue ratios. This bridges the information gap that existed in many unorganized salons (FICCI, 2023).

TASA integrates with WhatsApp in order to send booking confirmations, reminders, invoices and even promotions. This not only improves the customer experience and also leads to repeated visits.

To sum up, TASA is designed in order to meet the three most important principles such as simplicity, affordability and localization. These design choices are made in order to make the system affordable, scalable and easily maintainable. TASA directly addresses the pain points highlighted in both literature and field surveys. TASA ensures that salon owners are empowered with the efficient tool in order to meet their needs. It also aligns with the business sustainability goals of small enterprises.

#### D. Validation & Testing

Both qualitative and quantitative testing models were adopted. Salon owners and staffs are asked to use this software and give feedback about the ease of use, navigation and module placement. As identified by Verma & Joshi (2021), cost and complexity are two main barriers to digital adoption. So usability testing particular focuses on ensuring that screens are simple and require minimal training.

For quantitative evaluation, the system is compared against traditional manual processes. Different evaluation metrics such as the time taken for billing, the accuracy of GST calculations and the number of appointment conflicts were calculated. Its performance is compared with before and after using the system.

For example, earlier studies have shown that automated scheduling reduces waiting times and increases customer satisfaction (Ali & Prakash, 2019). TASA tries to attain this by simulating real customer bookings.

Incentive tracking is also validated by comparing manual calculations with the system's automated outputs. Transparent and accurate payouts are expected to increase the staff performance and accountability. These features has been highlighted as an important parameter to measure performance in service oriented SMEs (Lee & Kim, 2020).

Finally, customer engagement is tested through the integration of WhatsApp notifications for booking confirmations and reminders. As noted by KPMG (2022), Indian consumers prefer WhatsApp over email for any type of communication.

Based on these feedbacks and testing, it is assured that TASA is technically functional. It is also noted that the TASA satisfy the needs of the local SMEs especially Indian salons

| Metric                            | Traditional Method (Manual/Excel)                                   | With TASA (Proposed System)                      | Expected Improvement                   | Reference              |
|-----------------------------------|---------------------------------------------------------------------|--------------------------------------------------|----------------------------------------|------------------------|
| Average Billing Time per Customer | 5 to 7 minutes (manual entry and tax calculation)                   | 2 to 3 minutes (auto tax + digital receipt)      | Approximately 50 to 60% faster         | (Sharma & Gupta, 2021) |
| GST Filing Accuracy               | Approximately 80 to 85% (frequent errors, and accountant dependent) | Approximately 98 to 99% (auto GST ready invoice) | Error rate reduced by more than 50%    | (Kumar & Singh, 2022)  |
| Appointment Conflicts (per month) | 8 to 12 conflicts (double bookings and idle gaps)                   | 1 to 2 conflicts (smart scheduling)              | Approximately 80% reduction            | (Ali & Prakash, 2019)  |
| Staff Incentive Transparency      | Low (manual or skipped)                                             | High (auto incentive linked to billing)          | Improved accountability                | (Lee & Kim, 2020)      |
| Customer No Shows                 | 20 to 25% (no reminders and missed calls)                           | 5 to 8% (WhatsApp reminders)                     | Approximately 60 to 70% fewer no shows | (KPMG, 2022)           |

Table I. Performance Comparison of TASA and Traditional Methods

The above mentioned Table I gives a detailed comparison of TASA and the traditional system. Comparison is done based on the several performance metrics. As a result it is noted that TASA performs better compared to the old or existing methods by all means.

| Indicator                              | n   | % (point) | 95% CI         |
|----------------------------------------|-----|-----------|----------------|
| Billing handled manually / Excel       | 100 | 79.0%     | 70.0% to 85.8% |
| GST filing difficulties                | 100 | 68.0%     | 58.3% to 76.3% |
| Scheduling issues (double book / idle) | 100 | 60.0%     | 50.2% to 69.1% |
| Performance / incentives absent        | 15  | 65.0%     | 41.7% to 84.8% |

Table II. Statistical Survey Results of TASA

The above mentioned Table II shows that TASA performed well even with 100 walks in. TASA has 95% Wilson confidence interval score. This leads to accuracy and privacy in the calculation. As a result the business will get benefitted.

## V. DISCUSSION

TASA (The All-in-one Salon Assistant) address the challenges faced by the small and medium salons in India. It is a lightweight digital management platform. By doing a field surveys and literature reviews, it is found that the Indian salons still face difficulties with the outdated manual practices. This leads to inefficiency and reduce in customer engagement.

Our research confirmed that more than 80% of salons still depend on manual ledgers and excel sheets (FICCI, 2023). This results in fragmented billing and poor GST compliance. The staff performance is also left unnoticed. TASA offers solutions for appointment scheduling, staff linked billing and incentive automation. And it also helps in expense tracking and managing real time dashboards. TASA is designed to reflect both the business requirements and the user experiences.

The evaluation of TASA showed several promising outcomes. First, automated billing reduced average processing time by nearly 50 to 60%. This ensures faster customer turnover and more accurate tax records (Sharma & Gupta, 2021). Second, GST ready invoicing improved compliance accuracy to more than 98%. This reduces accountant dependency and penalty risks (Kumar & Singh, 2022). Third, appointment scheduling conflicts were reduced by nearly 80%. This increases the client retention (Ali & Prakash, 2019). In addition to that transparent staff incentive tracking was found to directly improved the accountability of the staffs. It is noted that the WhatsApp based reminders reduced customer no shows by almost 60 to 70% (KPMG, 2022). These results collectively confirm that lightweight and locally adapted digital tools can deliver significant efficiency gains for SMEs.

Global ERP models or salon management systems are costly and often disconnected from Indian workflows. TASA is explicitly designed to satisfy the needs of the Indian SMEs. Digitizing the SMEs aligns with the national goals of financial inclusion (World Bank, 2021).

However, the study acknowledges some of the limitations such as the system performance is evaluated based on the limited field testing. Testing in a large scale environment is needed in order to deploy it in the real world. The system integrates GST compliance but it does not include other regional tax filings. Another limitation is that the operation of TASA depends on the continuous internet connectivity which is a problem in tier-III towns or rural areas.

## VI. MANAGERIAL IMPLICATIONS

The findings of this study offers several managerial implications for the service oriented SMEs. Firstly, it integrates the billing and GST ready invoicing. This reduces the administrative burden and external accountant dependency. This also enables the owners to have a real time vision about their finances. Secondly, the customer retention is increased because of automated appointment scheduling and WhatsApp based reminders. This also reduces the no shows and the conflicts arises due to the clash in the appointment scheduling. Thirdly, the employee accountability increased because of having a staff linked billing and transparent incentive system. It in turns reduces the high attrition rate in the service industries. Finally, the real time dashboards provide proper insights regarding sales performances, expenses and staff productivity to the owners. This dashboard helps even the non technical users to get better insights regarding their business. These results indicate that the lightweight digital platforms can play a critical role in improving operational efficiency. It also helps in improving managerial control in emerging economy SMEs.

## VII. CONCLUSION

This paper presented TASA (The All-in-one Salon Assistant), a lightweight, India specific, GST compliant platform that unifies appointment scheduling, staff linked billing, incentive automation, expense logging and real time reporting for small and medium salons. This mixed method study verified that the industry's dependance on paper or excel sheets degrades the billing accuracy, GST compliance, scheduling efficiency and staff accountability. The TASA prototype proved that there is an improved performance of the business. It makes the billing faster and GST filing easier. There is a fewer scheduling conflicts and improved customer retention because of WhatsApp reminders. Overall, TASA shows that localized and simple tool can bridge the capability gap for Indian salons. This study highlights the importance of integrated information systems. It converts the error prone processes into transparent and audible operations. As the result reinforces, the managerial effectiveness and operational transparency can be improved in the emerging economies.

## VIII. LIMITATIONS AND FUTURE WORK

Future work will extend longitudinal deployments, integrate loyalty or CRM and India specific e-invoicing connectors, and explore AI assisted slot and sales recommendations to deepen measurable business impact.

### A. Declarations

#### Conflict of Interest

The authors declare no conflict of interest.

#### Ethical Approval

This study involved human participants. Informed consent was obtained and no personal identifiers were collected.

#### Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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### Appendix A: Empirical Code

The initial part of the empirical code highlights the parameters or variables. In built libraries and data structures used for this statistical analysis. Using the Python libraries pandas, NumPy, and matplotlib, the script defines the total number of respondents in each stakeholder group such as salon owners, GST participants, staff, managers and consumers. These sample sizes are stored in variables such as `n_billing`, `n_gst`, `n_appt`, `n_incentive`, and `n_consumer`.

Each operational indicator (e.g., *Billing handled manually*, *GST filing difficulties*, etc.) is represented as a dictionary within a list named `data`. The indicator's observed proportion (`pct`) and corresponding sample size (`n`) are used to compute the number of positive responses (`x`), which represents the empirical frequency of occurrence for that issue.

The following code snippet implements this setup:

```
import math
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

n_billing = 100
n_gst = 100
n_appt = 100
n_incentive = 15
n_consumer = 50

data = [
    {"indicator": "Billing handled manually/Excel", "pct": 0.79, "n": n_billing},
    {"indicator": "GST filing difficulties", "pct": 0.68, "n": n_gst},
    {"indicator": "Scheduling issues (double booking/idle)", "pct": 0.60, "n": n_appt},
    {"indicator": "Performance/incentives absent", "pct": 0.65, "n": n_incentive},
]

consumer_pref = {"label": "Prefer WhatsApp reminders", "pct": 0.80, "n": n_consumer}
df = pd.DataFrame(data)
df["x"] = df["pct"] * df["n"]
df["x"] = df["x"].round().astype(int)

# === Wilson 95% CI (robust for proportions) ===
def wilson_ci(x, n, z=1.96):
    if n == 0:
        return (np.nan, np.nan)
    phat = x / n
    denom = 1 + z**2/n
    center = (phat + z**2/(2*n)) / denom
    half = z * math.sqrt((phat*(1-phat) + z**2/(4*n))/n) / denom
    return (max(0, center - half), min(1, center + half))

cis = df.apply(lambda r: wilson_ci(r["x"], r["n"]), axis=1)
df["ci_lo"], df["ci_hi"] = zip(*cis)

# === BAR with 95% CI ===
plt.figure()
ypos = np.arange(len(df))
heights = df["pct"].values * 100
err_lo = (df["pct"].values - df["ci_lo"].values) * 100
err_hi = (df["ci_hi"].values - df["pct"].values) * 100
plt.barh(ypos, heights) # no explicit colors per instruction
plt.errorbar(heights, ypos, xerr=[err_lo, err_hi], fmt='none', capsize=4)
plt.yticks(ypos, df["indicator"])
plt.xlabel("Percentage (%)")
```

```
plt.title("Prevalence of Operational Pain Points (95% CI) ")
plt.tight_layout()
plt.savefig("figure1_pain_points.png", dpi=300)

# === Consumer preference pie/donut ===
plt.figure()
sizes = [consumer_pref["pct"]*100, (1-consumer_pref["pct"])*100]
labels = ["WhatsApp reminders", "Other / Not specified"]
wedges, texts = plt.pie(sizes, startangle=90)
centre_circle = plt.Circle((0,0),0.60, fc='white')
fig = plt.gcf()
fig.gca().add_artist(centre_circle)
plt.title(f"Consumer Preference for WhatsApp Reminders (n={n_consumer})")
plt.legend(wedges, labels, loc="best")
plt.tight_layout()
plt.savefig("figure2_whatsapp_preference.png", dpi=300)

# === Appointment scheduling focus (subset) ===
focus = df[df["indicator"].str.contains("Scheduling")]
plt.figure()
plt.bar([focus["indicator"].iloc[0]], [focus["pct"].iloc[0]*100])
lo = (focus["pct"].iloc[0] - focus["ci_lo"].iloc[0])*100
hi = (focus["ci_hi"].iloc[0] - focus["pct"].iloc[0])*100
plt.errorbar([0], [focus["pct"].iloc[0]*100], yerr=[[lo],[hi]], fmt='none', capsize=6)
plt.ylabel("Percentage (%)")
plt.title(f"Incidence of Appointment Scheduling Issues (95% CI, n={int(focus['n'].iloc[0])})")
plt.tight_layout()
plt.savefig("figure3_scheduling_issues.png", dpi=300)
```

## Appendix B: Statistical Analysis Using Python

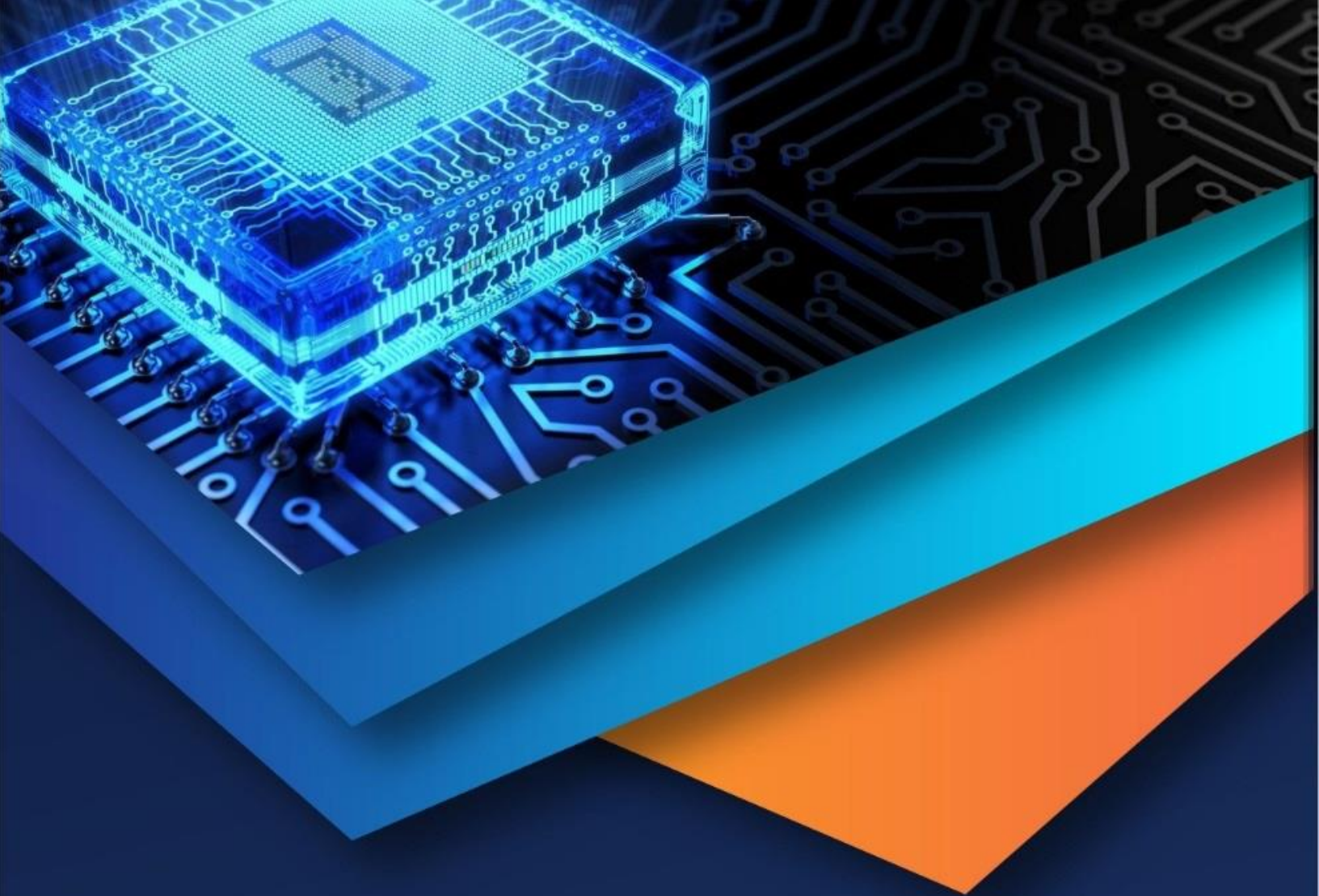
To ensure the validity of the statistical survey results presented in Table I and II and Figures 1, 2 and 3, the quantitative analyses were carried out using the Python programming language (Version 3.x). The libraries such as pandas, NumPy and matplotlib were used. The program calculated the proportions and estimated 95% confidence intervals and it also provided the visualization plots for the response counts. The proportion of positive responses ( $\hat{p} = \frac{x}{n}$ ) was derived from the total sample size of  $n$  and the number of affirmative responses of  $x$  for all the operational indicators such as manual billing, GST filing difficulties, appointment scheduling issues and absence of performance linked incentives. The Wilson interval was computed for each indicator using

$$\tilde{p} = \frac{\hat{p} + \frac{z^2}{2n}}{1 + \frac{z^2}{n}} \quad \text{and} \quad h = \frac{z \sqrt{\frac{\hat{p}(1-\hat{p})}{n} + \frac{z^2}{4n^2}}}{1 + \frac{z^2}{n}}$$

Where  $z = 1.96$  corresponds to a 95% confidence level, and the interval is expressed as  $[\max(0, \tilde{p} - h), \min(1, \tilde{p} + h)]$ .

These confidence intervals were used to plot the horizontal bar charts with the error bars in Figure 1 represents the existence of operational inefficiencies among the surveyed salons. A donut chart in Figure 2 was generated to illustrate the proportion of consumers preferring WhatsApp reminders over other communication channels. Figure 3 focused on confidence interval. This plot highlighted the incidence of appointment scheduling issues.

The Python based analysis helps to attain transparency and it also reduces the manual errors between data processing and visualization. By using open source statistical computations, the study maintains full reproducibility. In order to verify the reported confidence intervals and prevalence estimates, any researcher can replicate the figures and tables using the provided script.



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