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Digital Payments Transformation 4.0 – A Review and Research Agenda

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Abstract

Purpose: To study the evolution in payment and settlement systems in India and the current trends that are driving the digital transformation 4.0.

Methodology: Review of literature was done of payment systems, trends in banking, payment regulations and payment products. The study of technological advancements in banking and more specifically the payment domain was conducted through study of relevant articles, fintech products and websites of regulatory bodies. The conclusions of the study were drawn by studying advances in banking sector and analyzing the digital transformations in payments on Industry 4.0.

Findings: The study identifies multiple technologies using which end-to-end straight through processing (STP) can be achieved in payment industry. The study also suggests that, like industrial transformation, there has been a significant digital transformation in payments domain.

Research Implications: The Industry 4.0 works on the principle of adopt or perish. If banks or organizations do not adopt to new technologies, they may face possibility of being abandoned.

Originality / Value: Although various studies exist with respect to Industry 4.0, the study of the same from payments industry perspective has not been conducted. This study can help the organizations (businesses as well as financial institutions) understand the areas in which straight through processing can be achieved in payments domain. It can also be used as a strategy for digital transformation by other under-developed or developing nations.

Keywords: *Application Programming Interface, Banking 4.0, Distributed Ledger Technology in Payments, Digital payments transformation, Digital transformation 4.0, Industry 4.0, UPI 2.0.*

I. INTRODUCTION

The beginning of the current decade saw the emergence of Industry 4.0. Industry 4.0 and digital transformation have become the buzzwords of the decade. The rise of this fourth revolution is not just about digitization and integration of value chains in business verticals, it something more than that – it is the one that concerns stakeholders' satisfaction by establishing disruptive business models and digital solutions to customers. It involves organizational and operational change through integration of digital technologies, processes and competencies to create value for stakeholders.

Digital disruption is taking place in all the areas of economy and at all levels and banking is no exception. As the manufacturing and services industry passes through the revolution, it becomes crucial that the backbone of the industry, the banking sector, also adopts to the changing needs of the economy and comes up with innovative and digital solutions of doing transactions.

Focusing at the banking industry, payments domain is at the forefront of the banking industry. Globally, there has been an evident shift from manual paper-based payment systems to electronic payment systems and from batch processing to real time payment processing. Though the traditional payment systems are still being used, one cannot deny the impact of new innovations in the payments domains. Digitizing of payments has resulted in more data, control and automation.

This paper, therefore, aims to study the current trends in banking and the digital transformation in the payments sector. It seeks to understand whether transformation in payments has enabled to achieve straight through processing for organizations and whether it has been instrumental factor in Industry 4.0.

II. LITERATURE REVIEW

The study of literature was conducted to understand the evolution of payments and settlement system in India and the current trends in payments. The payment systems of any country can be divided broadly into 2

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categories - paper-based payment systems and electronic payment systems. The evolution of payment systems is India is, therefore, studied from paper-based as well as electronic payments perspective.

A. Shift from physical clearing to Cheque Truncation System

The Indian payment systems were mainly paper-based till 1990s. The paper-based clearing process involved passing on the physical copy of cheque or draft from the recipient's bank to the payer's bank via the clearing house. Since the physical copy of instrument had to be taken from one place to other for the purpose of clearing and there were multiple regional clearing houses. This resulted in increased turnaround time for processing of paper-based instruments.

In addition, the Banking Solutions were not centralized. Every branch prepared its set of books which were later consolidated. Starting 2003, the use of Core Banking Solutions resulted in efficient transfer of funds between the account holders of same bank and also other banks.

Later in 2008, the Reserve Bank of India introduced the Cheque Truncation System (CTS) replacing the erstwhile MICR based cheque processing. The introduction of CTS based clearing involved the payment processing using the cheque image and data captured from the cheque. Further, with the advancement in technology, activities such as signature verification, transaction accounting and clearing were all automated. As a result, the time involved in the clearing process of paper instruments reduced drastically, operational efficiency improved and the risks associated with paper clearing also reduced to a large extent.

B. Evolution in electronic payment systems

The electronic payment systems in India also witnessed a fast progress. The Electronic Funds Transfer (EFT) and Electronic Clearing Service (ECS) were introduced in India in 1990 which facilitated multiple credit transfers to beneficiaries. In 2005, National Electronic Funds Transfer (NEFT) replaced EFT and in 2016, National Automated Clearing House (NACH) replaced the erstwhile ECS. The NEFT and NACH transactions helped facilitate electronic payments in batch mode and achieve digitization of mandates, simplification of process thereby resulting in reduction of operational costs and minimization of activation time.

At the same time, Real Time Gross Settlement (RTGS) systems was introduced in 2004. The RTGS system facilitates the payments on real time basis with gross settlement service for wholesale / high value payment transactions. However, RTGS is a high value payment system and retails transactions cannot be done using RTGS. The need for this retail real time payment system was addressed in 2010 with the introduction of Immediate Payment Service (IMPS) which is Real Time Final Settlement (RTFS) service introduced by National Payments Corporation of India (NPCI). IMPS provides instant fund transfer, operates 24 x 7 and can be accessed on multiple channels. Table 1 below depicts the growth in the payment transactions from 2016-17 to 2018-19.

Table 1: Growth in digital payment transactions in India

Value (Rs. Billion)			
Transaction Type	**2016-17**	**2017-18**	**2018-19**
RTGS Customer Transactions	8,49,951	10,36,699	11,84,368
RTGS Interbank Transactions	1,31,953	1,30,426	1,72,514
Retail Electronic Clearing (ECS, NEFT, NACH, IMPS)	1,32,250	1,92,018	2,58,745
Cards Usage (PoS)	6,583	9,190	11,969
Prepaid Payment Instruments	838	1,416	2,129
UPI (including BHIM)	69	1,098	8,770
Total Digital Transactions	**11,21,644**	**13,70,847**	**16,38,495**

Source: Reserve Bank of India

Along with the regular banking services, banks have also started providing mobile banking services to enhance the customer experience. Not just the banking players have started coming up with innovative solutions, even the non-banking players started venturing in providing payment services to customers.

C. Rise of mobile banking and e-wallets

With the introduction of The Payment and Settlement Systems Act, 2007, the Reserve Bank of India authorized Payment System Operators to set up and operate in India. In 2009, MoneyGram Payment Systems Inc, USA and Western Union Financial Services Incorporated, USA became one of the first payment systems operators to establish their base in India to provide cross border money transfer services.

Similarly, many players entered the pre-paid payment instrument sector by providing wallet services like Ola Money Wallet (2009), Unimoni (2009), PayCash (2010), Oxigen (2010), Mobikwik (2013), PhonePe (2014), Amazon Pay (2017). In addition to this, many merchants such as Google Pay, Samsung Pay,

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WhatsApp, Swiggy etc. have come up to provide 3rd party apps for UPI transactions promoted by NPCI.

D. Advancement in card payment systems

The use of cards (debit and credit) in India began in late 1980 decade. These magnetic stripe cards were replaced with chip-based cards for better security and payment processing capability within the card itself. The National Payment Corporation of India has launched RuPay cards to have a domestic, open and multilateral system of payments.

E. Current Fintech scenario

The fintech sector in India has boomed due to blend of technology and finance that these companies bring to table. These companies are technology-based businesses that compete with existing financial institutions by providing a range of options such as e-wallet services, payment remittance services and introduction of blockchain and digitalization in banking. Many fintech have also partnered with banks to deliver digital solutions in payments processing.

The review of literature focuses on the evolution of banking, current trends in banking and its impact on the economic growth. However, the existing literature does not address the impact of technological and digital innovations in banking on Industry 4.0. The objective of this study is to therefore showcase how digital transformation in payments can be a significant driving factor in Industry 4.0.

III. RESEARCH GAP

To identify whether the technological advancements in banking have contributed in driving digital transformation 4.0.

IV. FINDINGS

We conducted our study on the payment and settlement systems in India along-with the recent development in fintech sector. The gathered the below findings on digital transformation in payments sector and its application for businesses, retail individuals and clearing houses.

A. Transformations from Corporate perspective

The literature review of payment systems in India clearly depicts the technological advancement in payment sector in India. With digital transformation 4.0 in the economy, the businesses need automation in all phases of operations. Starting from inventory management, production processing, logistics arrangement to recovery from customer, businesses are now looking at faster and efficient way of doing business with minimal human interaction. Banking is no exception to this. The technological advancements in banking have provided a boost to automation in all the areas of business operations.

1. Straight through processing of payments in organizations

Organizations do not look at banking in isolation. Many banking products are now embedded in the large processes of corporates. There are many examples wherein banking has been integrated with business applications.

The linking of ERP to banking software has helped to achieve straight through payment processing (STP) for corporates in following ways:

- **Payment scheduling and processing**: Organizations can schedule the payments to be made in advance. In fact, the ERP capability is used to identify the due date for payment and the payment processing of invoices can be made automated to make payment on the due dates.
- **Electronic Bill Presentment and Payment**: Business have started presented their invoices / bills to customer using Electronic Bill Presentment and Payment (EBPP) facility. This helps them to collect the amount due from customers on due date.
- **Multi-modal payment through single channel**: Organizations can make / receive payments through their ERP software by integrating their bank accounts with ERP system and using various payment modes available.
- **Batch processing of payments**: Bulk payments such as salary or expenses reimbursement require a lot of attention in terms of computation involved. Further, if the process is manual, the executives need to be sure that the data is downloaded properly and without errors and is handed over to banks in a secured manner. With automation and linkage of ERP to banks, the process becomes hassle free.

The linkage of ERP data with banking applications will results in better management of organizational receipts and payments. This integration can be achieved with the use of Application Programming Interface (API) technology.

In addition, the ISO 20022 Common Global Implementation (CGI) aims to streamline the electronic Corporate and Bank Connectivity. Figure 1 below depicts the flow of Corporate to Bank Connectivity:

With the integration to the banking interface, corporates can make payment through various banks using multiple payment channels such as RTGS, SWIFT etc.

Along-with this, the ERP can be connected with SWIFT terminals in case the corporates opt for SCORE

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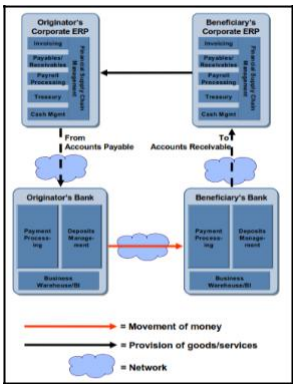
(Standardized Corporate Environment) and send payment messages anywhere across the globe.

Figure 1: Flow of Corporate to Bank Connectivity



Source: MDA Journal – Author: David Frankel

2. Management of treasury functions

- **Cash management**: Cash management can be done by depositing idle funds of the organization in linked deposits and liquidating the deposits in the event of cash crunch. Further, the banking applications can be used to trigger automatic loan disbursement in the event of inadequate funds for payment processing (which could be automated as seen earlier).
- **Automatic processing of loan**: When a large purchase decision is made using ERP, loan facility is automatically triggered by the bank. This is at a nascent stage in India though.

B. Transformations from Retail perspective

1. Real time payments

India was one of the early adopters of real time retail payment system in 2010. With the introduction of new payment services such as Immediate Payment Service (IMPS), Bharat BillPay, Aadhaar Enabled Payment Systems (AePS), retail individuals are now able to move money on a real time basis round the clock 24 x 7. The Unified Payments Interface has gained momentum due to the various features such as scan and pay, single click 2 factor authentication, bill sharing services and many more.

Unstructured Supplementary Service Data (USSD) service using Global System for Mobile (GSM) communication technology is also used for initiating payments using the IMPS service. It facilitates instant fund transfers and can be used for balance enquiry and generating mini statement on a basic phone as well.

2. Automation of payments by creation of mandates

Banks in India provide the facility of mandate creation for payment of supplier's dues. With the mandate in place, the amount due to service providers / creditors such as electricity company, telephone company, bank loans can be made on the due date without the need to worry about the defaults and allied consequences.

3. NFC Chips with Offline Payment Processing Capabilities

The technological innovations have replaced the magstripe cards with Near Field Communication (NFC) enabled chip devices. The chip cards come with Offline Payment Processing Capabilities. It means that the chip card has the ability to process the payment transaction offline despite having no connectivity. In such offline transaction, the card and terminal can communicate and use risk parameters set in the card to determine whether the transaction can be authorized. These transactions are used when terminals do not have online connectivity or in areas where the cost of internet connectivity is very high.

Further, the NFC chips can be embedded on the mobile phone or can be attached to human beings as shown below. This enables the user to make payments on the go without the need to swipe the card on the POS machines and with added security as compared to magstripe cards (See Fig. 2 below)

Figure 2: NFC chip card embedded on nail

Source: Search Engine

4. Use of Unified Payment Interface (UPI 2.0)

The development of UPI 2.0 offers many benefits to the individuals such as

- **Movement of money from customer to merchant having different Payment Service Providers (PSP).** UPI 2.0 enables customer - merchant transactions even in case of the customer and merchant have accounts with different service providers.

Example: Customer has a Paytm account and wishes to make a payment to the merchant having Google Pay, then the same is possible using UPI 2.0 mechanism. When the customer initiates a fund transfer, the message flows to its Payment Service Provider (PSP) which then carries the payment message to the merchant's PSP for validation and confirmation. On receipt of confirmation, the message flows to both customer's and merchant's bank for settlement.

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- **IPO Application Process:** UPI 2.0 allows use of UPI while subscribing for the Initial Public Offering (IPO). The subscriber can fill the IPO subscription form using his UPI id which enables the creation of a mandate and the amount of subscribers gets blocked. On allotment of the securities, the funds are automatically adjusted against the blocked amount. In case of partial allotment or non-allotment of securities, funds pertaining to unallocated securities are unblocked / released for use.
- **Requesting money:** UPI 2.0 enables customers to pull money / collect money from the payer. The requestor has to create a pull request which when approved by the payer enables to transfer money from the account of payer to the requestor. All this can happen within a few minutes and thereby enhances the user satisfaction.

C. STP for payment processing within banks and clearing houses

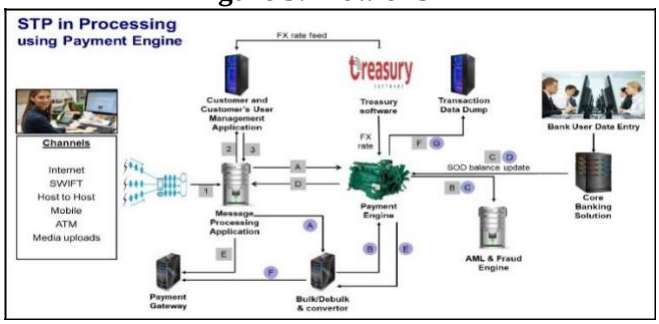
All the above measures indicated that payment transformation has resulted in straight through processing (STP) of payments by corporate and retail sector resulting in saved cost and efforts. The same can also be observed in payment processing within the financial institutions. Various applications provide the STP functionalities in payment systems. Some of the examples include IBM Payment Director, Fundtech Global Payplus.

The STP involves the areas such as:

- Message authentication and message parsing
- Message analysis
- Payment accounting, payment authorization and payment routing

The flow of Straight-Through Processing (STP) using payment engine is provided below in Figure 3 below:

Figure 3: Flow of STP



Source: Certified Payment Processing Specialist (CPPS) course note of MVL Consulting Private Limited

When the customer initiates a payment using channels such as Internet banking, mobile banking, ATMs etc., the details flow to the message processing application in the bank. The same information flows to customer user management application for authentication of customer data. Once the same is authenticated, the details flow to the bank's payment engine which scans the information through AML and fraud engine to detect laundering or fraudulent activities.

If the transaction passes through the AML and fraud engine, the payment transaction moves to Core Banking Solution. If the CBS accepts the payment to be made, the same is updated by posting an entry in the CBS.

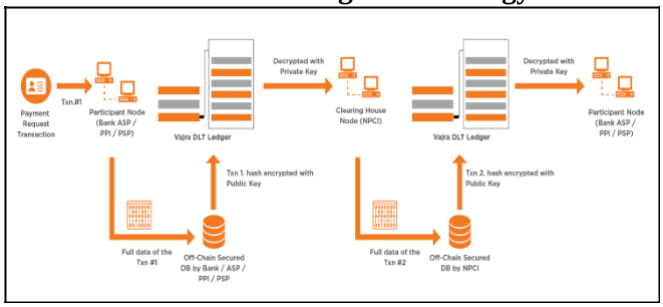
Post this, the payment engine instructs conversion solution to create payment message in the format required by destination system. Conversion solution sends the message in required format to messaging engine. Messaging engine chooses appropriate payment gateway to send the message outwards and the transaction dump is updated. Advising engine advises the remitter/beneficiary using appropriate method and transaction status is updated to user after updating the user log with user activity. The process can be further automated by posting of the transaction in the Core Banking Solution of the bank.

The entire process helps to achieve STP within financial institutions, thereby ensuring end-to-end transformation starting from transactions generated from customers to processing the transaction within the financial institutions and ultimately accounting for the same in the books of account.

D. Other advancements in clearing and settlement

NPCI has recently in 2020 introduced distributed ledger system for automated payment, clearing and settlement on 'Vajra' platform. It is designed to automate the process of clearing and settlement of NPCI products. Though the platform is not being put to use, it is expected that the use of distributed ledger technology would bring automation and transparency in clearing process and help to create audit trail. It is expected to bring near real time clearing and settlement and increased data security due to use of encryption. The entire process (as depicted below) would be automated and help achieve STP. The process is expected to work as indicated in Figure 4 below:

Figure 4: Payment processing using Vajra Distributed Ledger Technology



Source: National Payments Corporation of India

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The payer or payee can initiate the transaction on Payment App or using net banking or POS or MicroATMs. The requirement would then pass on to the server of the initiator's bank which will record the transaction on the Distributed Leger Technology (DLT) Platform using Application Programming Interface (API) or adapter. The transaction would then be validated using the defined business rules. The successfully validated transactions will be recorded on the DLT platform and be viewed by participating institutions or clearing house. These cleared transactions would then be picked by the Clearing House at set frequencies for the process of clearing and settlement.

V. CONCLUSION

The technological advancements in payments domain have resulted in following:

- Straight-through processing within banks and financial institutions
- Automated payment processing and bill collection for corporates
- Real time payment services to retails customers
- Offline payment processing capability within card

It can be concluded that technological advancements have enabled payments industry to adapt to Industry 4.0 by increasing its speed of processing and reducing manual intervention.

Expected benefits of the study

This study can help the organizations (businesses as well as financial institutions) understand the areas in which straight through processing can be achieved in payments domain. It can also be used as a strategy for digital transformation by other under-developed or developing nations.

Scope and Limitations

1. The study is based on literature review. The impact of payment transformation on Industry 4.0 has not been computed.
2. The study focuses on technological advancements in payment systems in India only. Other banking innovations are not covered in the study.

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