DSS for Cash Management in Indian Microfinance Institutions : A Brief Review of Literature

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Abstract

The paper tried to identify a suitable approach to propose a Decision Support System (DSS) for cash management in MFIs. The paper reviewed microfinance literature by identifying the issues in the sector and further justifying the need for cash management DSS. Thereafter, it reviewed cash management literature by making a classification based on sub problems and approaches to mitigate it in order to identify the approach which will help managers in their day-to-day decision making. Finally, it reviewed DSS literature and classified it according to application and technique to justify the approach identified from the cash management review. The paper identified System Dynamics (SD) as the technique or approach for the future development of DSS for cash management in MFIs.

Keywords: **microfinance, microfinance institutions (MFI), cash management, cash planning, cash balance, decision support system (DSS), management information system (MIS), system dynamics (SD), simulation**

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Microfinance promises both to combat poverty and to develop an institutional capacity of financial systems for lending money to poor households in a cost-effective way (Morduch, 2000). A typical MFI operation includes: village selection, center formation, financial transactions, internal audit of expenses, deployment of human resources, cash management, and implementation of management information systems. The operations can be classified as customer-facing field operations and back-office operations (Waterfield & Ramsing, 1998).

MIS provides information for better handling of various issues related to cash management. Microfin 4 is a spreadsheet based MIS, which provides necessary information to the managers for cash planning of the MFIs (Lunde, Sheldon, & Waterfield, 2006). SHARE Microfin Limited's MIS generates reports for the MFI on the basis of the weekly report received from its branch offices. This report contains a brief narrative from the branch manager on key statistics for the week, number of groups formed, number and amount of loans disbursed, repayment rate, cash position, projections for the following week, and any new issues relevant to the MFI (Waterfield & Ramsing, 1998). One of the top microfinance institutions in India, SKS implemented an integrated web-based cash MIS to reduce the float in its branch offices (SKS Microfinance, 2009). However, the existing MIS technology only provides information to the manager and does not provide any model to the managers for better management of cash. The growing competition has also put pressure on the MFIs to manage their cash with the help of modern information systems (Kauffman & Riggins, 2012).

This has created an opportunity to use advanced technologies such as DSS for effective cash management in MFIs. Strategic issues and challenges in the microfinance industry have been identified through a review of

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Table 1. Issues and Challenges Faced by the Microfinance Sector Along with the Respective Citations

Issues and Challenges	Citations
Increasing accessibility	Imai et al. (2010)
Overcoming information asymmetry	Guirkinger (2008)
Accessing subsidized capital	Hollis & Sweetman (1998); Ahuja & Jutting (2004); Tucker & Miles (2004); Ly & Mason (2012); Dailey (2005)
Deciding on interest rate policy	Hollis & Sweetman (1998); Mallick (2012)
Expanding operations	Kwon (2010)
Reducing agency cost	Jeon & Menicucci (2011)
Reducing arrears	Kwon (2010); Norell (2001); Schreiner (2000, 2001, & 2004); Schaaf (2010) ; Khavul (2010)
Deciding loan size	Norell (2001); Schreiner (2001)
Trading off between poverty alleviation and sustainability	Copestake (2007); Tucker & Miles (2004)
Responding to supervision	Hollis and Sweetman (1998); Cull et al. (2011)

literature. One of the issues of financial self-sufficiency could be resolved through better cash planning. The cash management problem and the approaches to mitigate it have been described using the review of literature undertaken in the present study. One of the approaches available in literature to tackle the cash planning within an organization is System Dynamics (SD). Similarly, the review of literature on DSS has identified SD as one of the modelling tools for developing DSS. The literature on cash management and DSS has used SD in strategic level decision making and captures dynamic, complex interrelationships among the variables. Thus, the review of available literature on cash management and DSS proposes the development of SD based DSS for effective cash management of Indian MFIs.

Review of Literature to Identify Issues and Challenges of MFIs

Balasubramanian (2008) suggested that microfinance programs can be assessed at the individual, household, enterprise, village, and institution level. A review from the institution's perspective is provided in the Table 1.

The Table 1 refers to the issues faced by the MFIs along with the references. These issues would help in taking decisions and building scenarios for testing. Commercialization of MFIs requires the implementation of new and advanced support systems. Gibbons and Meehan (2000) suggested that institutional financial self-sufficiency (IFS) is necessary for a microfinance institution (MFI) for obtaining a large volume of funds. Having access to capital markets gives a MFI greater financial freedom and makes a MFI less reliant on donor capital. But financial self-sufficiency requires proper cash management by microfinance institutions. Cash management is an important function for the banking financial services. Mclean and Riesing (1977) advocated the development of a Decision Support System (DSS) for financial planning. The DSS mainly deals with the optimization of the budgeting process in Citibank. Castro (2009) applied a stochastic programming technique for cash planning in banks. Microfinance is a sector that is engaged in offering financial services to people ; thus, cash management is a crucial function for this sector.

Review of Literature on Cash Management Issues

Cash management is concerned with the management of cash inflow, cash outflow, and cash balance of an organization (Pandey, 2010). Akoka (1981) suggested that the cash management problem is a semi structured problem, and it should be under operational control. A study by Srinivasan and Kim (1986) on cash management

revealed, “the cash management decision process can be decomposed into five major decision types: (i) cash balance management, (it) cash gathering, (iii) cash mobilization and concentration, (iv) cash disbursement, and (v) banking system design for credit services” (p. 350). Thus, overall, cash management is associated with various sub-problems and issues like cash balance, cash collection, and disbursement; cash planning and budgeting. The present section provides a review of literature on the various issues related to cash management so that the readers can familiarize themselves with the approaches available for tackling the sub problems of cash management. This will help in identifying the problems and approaches available for effective cash management in MFIs.

↳ **Problems Associated With Cash Balance, Cash Collection, and Disbursement :** Baumol (1952) analyzed the transactions demand for cash dictated by rational behaviour, which indicates holding of the cash balances that can do the job at minimum cost. Miller and Orr (1966) developed a simple, analytical model that incorporated both "up and down" cash balance movement characteristics of business operations and the critical, lumpy transfer cost feature of the Baumol (1952) model. Miller and Orr (1968) assumed that the earning assets are homogeneous, leading to a “two-asset” (cash and securities) formulation, and ignored the importance of portfolio interaction in cash management. The costs dealt within the model are of two types: a cost of cash-portfolio transfer that is "lumpy," and an opportunity cost of holding cash.

Weitzman (1968) suggested, “the prospect of running out of cash forces a firm to draw appropriate managerial attention on a scale of priority far higher than would be the case for converting excess cash into bonds” (p. 161). The paper presented a formula for expected cost per day for managing a firm's cash balances over a certain period. Pogue, Faucett, and Bussard (1970) suggested that corporations maintain cash balances as the inflow and outflow of cash payments are not perfectly synchronized. Furthermore, corporations may use cash balance to compensate banks for a variety of services they provide. The paper focused on the problem of determining the optimal level of cash balances that need to be maintained for supporting a firm's banking system.

From the review of the above-mentioned literature, it can be seen that DSS uses the inventory approach to tackle the cash balance problems.

Sastry (1970) made an attempt to develop a model which included "cash-out" costs in addition to the conversion or transfer costs, opportunity costs, and earnings lost by idle cash. Neave (1970) contended, “the stochastic cash balance problem is an expected-cost-minimization problem faced by an economic entity which makes recurring decisions regarding the size of cash balance (currency or demand deposits) it holds” (p. 472). The stochastic cash balance problem is formulated as a dynamic, multi-period inventory problem, in which the stochastic variable (analogous to demand in the more usual inventory formulation) can take on either positive or negative values. Previous work on the stochastic cash-balance problem has assumed holding costs for holding excess cash, and these costs are assessed per period basis. However, Hausman and Sanchez-Bell (1975) remarked that this formulation is appropriate when a firm faces minimum (or zero) compensating-balance requirements, but not when the compensating-balance requirement involves an average deposit balance over a number of decision periods.

Eppen and Fama (1971) pointed out that to meet its day-to-day transactions requirements, a firm keeps cash balance either in the form of cash in hand or as a bank deposit. In controlling the level of cash, the assumed goal is to choose an operating policy that minimizes discounted expected costs over some horizon period. The authors were concerned with situations where the differences between the expected returns, and the transfer costs on "stocks" and "bonds" are such that it pays for the firm to hold some "bonds" as a buffer against fluctuations in the cash account. Mehta (1974) examined cash management from two different approaches: the inventory theory approach and the portfolio management approach. In the former case, optimal cash balances are viewed in an EOQ framework using the Miller-Orr model. In the latter case, cash is considered as a financial asset and optimal balances are decided in light of the risk-return characteristics of other financial assets via the Markowitz and Sharpe models.

Pate-Cornell, Tagaras, and Eisenhardt (1990) developed an approach for cash flow management using the

perspective of a general risk management problem and the paradigm of decision analysis. The risk analysis approach proves upon inventory-based approaches because the range of options available to the decision maker is broader and more realistic. Hinderer and Waldmann (2001) evaluated a cash management system, in which the distribution of the cash flow X_n in period n =1, 2… depends on the state of a randomly varying environment. Sufficient conditions are found for the optimality of a simple transfer rule, generalizing and partially improving the well-known results for the classical cases.

The above research works thus suggest different dimensions of the cash balance problem. These dimensions such as cost, interest rate, holding of bonds, forecasting of cash balance based on cash inflow and outflow are truly reflective of the problems faced by the treasury of various corporations. Another important aspect of cash management is the development of an efficient receivables collection system that makes it possible to collect payments quickly from a number of widespread customers. Two basic cash management strategies are: collect accounts receivable as quickly as possible, and pay accounts payable as late as possible. Gitman, Forrester, and Forrester Jr. (1976) dealt with the maximization of the disbursement float by suggesting to collect receivables without losing future sales due to high pressure collection techniques and to pay creditors without damaging the firm's credit ratings and supplier relationships. One approach to collect payments from widespread customers is to maintain lock box accounts with banks in several strategically located sites by minimizing both the opportunity costs of uncollected funds and lock box service charges (Levy, 1966; Nauss & Markland, 1979 ; Stancill, 1968).

↳ **Problems Associated with Cash Planning and Budgeting :** Cash planning and cash budgeting are the two techniques of cash management. These techniques help to anticipate the future cash flows, need of the firm, reduce the possibility of idle cash balances, and cash deficits (Pandey, 2010).

Stone and Wood (1977) identified two generic methodological approaches to cash forecasting: distribution and scheduling. Distribution is a statistical approach, which refers to spreading a forecast of the total monthly flow over the days of the month to reflect known intra-month cash flow patterns. Scheduling refers to the construction of the forecast from primitive data. It is an information system based forecasting that captures and organizes the invoice data.

Stone (1973) contended that the techniques available for forecasting cash inflow and outflow may result in error. It is important that a financial manager prepares a cash budget and estimates its expected cash outflows and inflows with accuracy. Simulation is ,therefore, an approximate tool which can be used for this aspect of financial management (Lerner, 1968).

Thompson (1986) used a simulation tool called System Dynamics (SD) for improving cash flow management in small firms which suffered from uneven sales. It suggests that the cash flow pattern of small firms can fluctuate greatly. Receivables, payables, and cash are complexly related and ever changing. Furthermore, it suggested that the firm's cash flow and profit do not go hand in hand, and the need for external financing puts pressure on the management to plan their cash flow in a better manner.

Kolay (2007) pointed out that working capital needs of an organization depend upon a multitude of factors, such as level of operational efficiency, service level, inventory policies, and debt policies. Similarly, financing of an organization is based upon the extent of internal cash generation, availability of credit limits, and relative cost of capital among various other factors. All factors are time dependent and dynamic in nature. Therefore, the study employed system dynamics as a technique to analyze the interaction of the variables and evolved suitable strategies.

Castro (2009) obtained a discrete probability distribution relating to the uncertain demand of customers of a bank from historical data and used stochastic programming techniques for cash planning. Cheng, Tsai, and Liu (2009) used artificial intelligence (AI) approaches for predicting cash flow trends for the projects. These approaches developed appropriate strategies that apply factors like float, process execution time, construction rate, and resource demand for cash flow control of projects.

Yi-Han and Hong-Xin (2010) established a cash flow model of 80 listed companies using system dynamics

Table 2. List of Available Literature on DSS Based on its Application and Methodology Along with the Respective Citations

Areas	Citations
Application	
DSS in Banks	Brans et al. (1993); Sprague & Olson (1979) ; Cale & Eriksen (1994); Adam et al., (1998) ; Kanungo et al., (2001) ; Ji (2009)
Other Applications of DSS	Green et al. (1984); Mohemad et al. (2010) ; Riad et al. (2010)
Methodology/ Approach	
Simulation based DSS	Seaberg & Seaberg (1973) ; Lendermann et al., (2007); Besharati et al. (2006) ; Tako & Robinson (2010)
System Dynamics based DSS	Brans et al. (1993) ; Quaddus & Intrapairot (2001) ; Weber & Schwaninger (2002); Yim et al. (2004); Azmi et al. (2012)

methodology. The model was used to carry out dynamic simulation to control the real-time cash flow data of the enterprises.

The minimum cash balance decision is a policy level decision. A causal loop diagram captures this decision variable, which is exogenous to the model. However, the physical flow of cash leads to daily cash balances, which may not be the minimum cash balance. The system dynamics approach helps in planning the daily cash balances based on the regular cash flow. The review of the research studies suggests that SD is one of the techniques, which can be used suitably for cash planning within an organization. As forecasting techniques are separate for long term and short term cash planning, that is, they are a sequential process, but the use of simulation removes this limitation while planning. Furthermore, this approach will be useful in daily cash budget updating based upon the behaviour of the cash balance and float in the system.

Selective Literature on Application of the Decision Support System

Keen and Scott Morton's textbook on DSS provided the first broad behavioural orientation for analysis, design, implementation, evaluation, and development of DSS in the mid - to late 1970s (Liu, Duffy, Whitfield, & Boyle, 2010) . According to Sprague and Watson (1993), the basic framework for a DSS consists of three major components: model base, database, and a dialog system.

The present study attempts to develop a DSS for MFIs in India. The review of existing literature has presented that the SD methodology is an appropriate tool for developing DSS of an organization. The Table 2 presents a categorization of the available literature on DSS based on its applications and methodology. The problem areas of DSS in banks are later identified and based upon the methodology used, further classification of DSS is done.

↳ **Research Studies on the Application of DSS :** Brans, Marescha, and Mertens (1993) used a micro-computer based DSS for the analysis of the international banking sector. This DSS is particularly useful for international divisions, correspondent banking, foreign exchange, and money market departments of financial institutions with international relationships. Sprague Jr. and Olson (1979) described a Financial Planning System (FPS), which is an integrated system with the provisions of analysis of historical data, short and long range forecasting, and simulation modeling. The system enables a bank to identify the ways to restructure its asset and liability relationships and allows it to test alternative action plans. Wu and Hsien-Chang (1992) presented a general framework of DSS for the banking system. The framework consists of five components, that is, the database, the model base, the computer, the user (banker), and the communication mode. It also presents a credit analysis model based on the scoring system.

Cale and Eriksen (1994) presented an overview of a DSS that assists managers of large commercial banks to establish the prices (interest rate) for a money market deposit account (MMDA). The system employs a series of

statistical models that predict future trends. The statistical models were developed using the regression capabilities of the Minitab statistical package. Adam, Fahy, and Murphy (1998) said that the novelty in the DSS applications for banking & financial services is high. Kanungo, Sharma, and Jain (2001) assessed the credit appraisal system developed in Quattro Pro at an Indian commercial bank and suggested that credit appraisal has emerged as a critical sub-function due to the growing incidence of non-performing assets. This system helps in the analysis of balance sheets, calculation of financial ratios, cash flow analysis, future projections, sensitivity analysis, and risk evaluation as per the norms of the bank. Ji (2009) presented the potential of DSS development in the commercial bank industry with respect to two crucial areas, that is, credit management and cash management.

↳ **Research Studies on DSS Based on its Methodology :** Quaddus and Intrapairot (2001) formulated an easy-to-use DSS based upon the SD model. The DSS contains seven policy slide bars (i.e., fixing a scenario), and the user can run the simulation. The results are displayed in the form of graphs and tables. Using this DSS, the authors analyzed the impact of the policy variables on the decisions. The strategic policies were identified by the staff members of the bank. Weber and Schwaninger (2002) proposed the use of SD methodology as a tool for developing DSS. The tool is necessary to elicit the mental constructs of the actors and to clarify and structure the debate about the situation which is perceived as problematic.

One of the important reasons for the usage of SD as a DSS development tool is that it would be possible to generate a reference mode of behaviour for the system, and the decisions on the issue would have a long-term impact. Yim, Kim, Kim, and Kwahk (2004) contended that the method transforms individual mental models into explicit knowledge by translating partial and implicit knowledge into an integrated knowledge model (using the SD approach). The scenario-based test of the organized knowledge model enables decision-makers to understand the structure of the target problem and to identify its basic cause, which facilitates effective decision-making. A SD model allows for more effective trade-off analyses among different design options. The true value of using a SD model has the opportunity to examine 'what-if' scenarios before allocating scarce time, budget, and personnel resources to solve the problem.

According to Azmi, Liaghat, and Sarmadi (2012), the results revealed the high capabilities of the SD approach in modelling water resources and irrigation systems. This approach is user-friendly and the ability to transfer data to the data bank helped in introducing this approach and software as an applicable decision support system.

Therefore, it can be observed that the SD model and its methodology put emphasis on conceptualization, formulation, and simulation of a system. As SD models represent the management decision structure and can be experimented in terms of "what if?" types of analysis, they can be used as a good base for the development of DSS for various managerial problems. Based on this viewpoint, the present study also proposes the potential of System Dynamics (SD) for the development of DSS for resolving the cash management problems in MFIs.

Research Implications

The literature review on the microfinance industry identified the issues and challenges faced by the industry while making decisions. The selective literature review on DSS in banks suggests that the problem area it mostly deals in is financial planning, cash management, and credit management. The literature review on cash management further details out the problems in the area and the approaches to resolve it. System Dynamics has been used for cash planning in small firms. Furthermore, literature review on DSS based on methodologies suggests that System Dynamics based DSS is used for scenario testing. This new approach could be used for cash planning in the microfinance industry. The issues identified in the industry would help in building the scenarios under which the DSS tool can be tested.

The present paper would aid academicians in understanding the problems faced by the microfinance industry. These issues have been raised in various separate literatures, but none of them have tried to look at the technical solutions. These problems can be tackled by using the DSS tools. Therefore, the DSS literature has been reviewed

to find a suitable methodology to deal with the cash management problems particularly faced by the microfinance institutions. The literature review on DSS in banks will help technology providers to provide suitable tools for future use in the financial services sector. The literature review on cash management would help practitioners to look at the existing solutions for the problems in domain and adopt the methodologies for new sectors such as microfinance.

Conclusion

The key challenge of this interdisciplinary research was to bring various disciplines of MFIs together to gain effectiveness in the management process. This paper tries to present a balanced review of the various disciplines of MFIs. The study has laid the foundation work for furthering the review process in the discipline of cash management.

The paper describes different approaches available for solving the sub problems of cash management of MFIs. One of the sub problems of cash management is cash planning, which mainly involves cash flow forecast approaches. Other approach used for cash planning in small firms as described in the literature is the application of the System Dynamics (SD) approach (Thompson, 1986). This approach seems to be suitable for MFIs as they can be compared to small financial intermediaries. Furthermore, being a financial intermediary, MFIs entail a lot of interactions with banks and joint liability groups, thus giving rise to a complex relationship between cash and loan portfolio. The SD based simulation model can be used for developing DSS for cash management in MFIs, which will help the managers in seamlessly performing their day-to-day activities.

Limitations of the Study and the Way Forward

The present study is limited to the literature review for finding an approach for cash management in microfinance institutions. It does not build the model for application in the industry. Furthermore, optimization techniques have not been explored for building such a DSS. The DSS application has only been explored for cash management problems occurring in microfinance institutions. Other issues of the microfinance institutions have not been taken up for finding suitable methodologies for solution. The literature review on cash management was not segregated for the financial services sector and other sectors. These limitations can be explored and worked upon by researchers in future studies.

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