

Critical Success Factors Analysis (Fuzzy-DEMATEL) for Rural Technology Adoption Specific to CIFCL Rural Branches

Vaivaw Kumar Singh¹, Kunal Sinha²

¹Research Scholar, Faculty of Business Management, Sarala Birla University, Ranchi, Jharkhand, India

²Assistant Professor, Faculty of Commerce, Sarala Birla University, Ranchi, Jharkhand, India

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Abstract: Rural technology adoption in emerging markets is still a very complicated problem with infrastructure, socio, economic, cultural and institutional barriers. In the case of rural financial service providers like CIFCL (Cholamandalam Investment and Finance Company Limited), the successful rollout of technology, based solutions depends on a detailed understanding of the critical success factors (CSFs) that are specific to the rural branch ecosystem. This study combines various literature works done in the areas of rural technology adoption, CSF identification and decision, making frameworks with special focus on the adoption of the Fuzzy, DEMATEL (Decision Making Trial and Evaluation Laboratory) method.

The literature survey has come up with a list of the most frequently mentioned CSFs in rural technology adoption, like infrastructure readiness, leadership support, digital literacy, cost affordability, and regulatory environment, and has proposed methods for analyzing their interaction based on fuzzy causal models. The suggested use of Fuzzy, DEMATEL in the CIFCL rural branch scenario allows for the sorting of CSFs into cause and effect groups giving management the opportunity to concentrate on the root causes that trigger wider systemic reforms. Among the main findings, leadership commitment, staff training and infrastructural investment emerge as the major sources of downstream success, e.g. user adoption and client trust. Further, this review calls for more empirical research specific to CIFCL and other similar rural institutions, underlining the significance of dynamic, data, driven models in supporting inclusive, scalable, and sustainable rural digitization strategies.

Keywords: Fuzzy-DEMATEL, Critical Success Factors, Rural Technology Adoption, CIFCL, Digital Financial Services.

I. Introduction

Technology adoption in rural areas is frequently a lot more complicated than that in urban or well-served areas. The barriers can be the physical infrastructure, literacy, socio-cultural norms, financial situations, trust, and so on. For a financial services organization like CIFCL (Customer Inter-Financial or Microfinance branch network) that is working in rural branches, the adoption of technologies, digital banking, mobile apps, automating operations, data analytics, or remote client interactions, will drive the successful implementation of the organization's mission, i.e., to increase efficiency, inclusion, reduce costs, improve reach, and achieve compliance.

It is useful to know the critical success factors (CSFs) that are essential in a particular context and their mutual influence to ensure the adoption is successful (i.e. it is sustainable, accepted, used, and delivers benefits). Fuzzy-DEMATEL (Decision Making Trial and Evaluation Laboratory combined with fuzzy logic) is perfect for this: it facilitates the identification, weighting, and mapping of the cause, effect relationships among the CSFs, especially when the uncertainty vagueness (experts' subjective judgments) is present.

This review article to delineate, to be specific, the rural technology adoption CSFs; to define how the Fuzzy, DEMATEL method was used in other cases; to present the new consideration for CIFCL rural branches; as well as to provide the possible CSFs and their interrelationships together with the practical implications.

Background

CIFCL Rural Branches, Context and Challenges

What are typical problems of rural branches?

- Insufficient or unreliable physical infrastructure (power, roads, internet connectivity)
- Poor digital literacy of clients / low trust in technology
- Insufficient employee training, workforce capacity, resistance to change
- High costs of implementing technology (procurement, maintenance) and for continuous operations
- Some of these factors are cultural and socio-economic: what clients think of technology, social norms, gender issues.
- Regulatory, policy, security, risk, and governance, related constraints

When we analyze CSFs, we have to consider the specificity of their context: rural India (for example) has different infrastructural, socio-economic, cultural, and regulatory environments than urban areas or other countries.

Technology Adoption in Rural Settings, what is known

The literature mentions essential factors that significantly impact how rural areas adopt technology, these are:

- Perceived usefulness and perceived ease of use (originating from Technology Acceptance Model and unified adoption theories)
- Knowledge and the spreading of the information among the possible users
- The cost of the product (initial and ongoing) and affordability
- Rural infrastructure (electricity, connectivity, hardware, software)
- Trust, security, privacy concerns
- Social influence and community norms
- Skills / capacity: user capability and institutional staff capacity
- Support from leadership / management, stakeholder involvement

The research on the adoption of fintech, mobile health, agricultural technologies, remote monitoring, etc. has found that there are numerous similarities, albeit that the relative importance of these factors varies by country, region, technology type.

Critical Success Factors (CSFs) Concept

A Critical Success Factor is the mainstay that is at the very center of any successful implementation. It is not just any factor, but one without which success is hardly probable or much more difficult to achieve. In technology adoption, CSFs refer to the few key areas where it is necessary for things to go well for the project to succeed.

CSFs have value because:

- They allow prioritising the areas where the limited resources should be allocated
- They direct the focus of planning, monitoring, and management
- They facilitate the development of roadmaps or action plans

Many of the CSFs are interdependent; some lead to others, while some are outcomes. Grasping this cause, effect relationship enables more precise intervention: addressing the underlying causes will result in downstream benefits.

DEMATEL, fuzzy logic, and Fuzzy, DEMATEL fundamentals

DEMATEL is a technique that helps identify the causal relationships between the factors/criteria of a system. It employs pair, wise expert judgments to build a direct, influence matrix, and then through mathematical processing (normalization, total influence including indirect effects) one can figure out which factors are “cause” vs “effect”, as well as the ranking of factors.

Why fuzzy? Although real expert judgments are most of the time vague, they are usually linguistically expressed (“High”, “Medium”, “Low”) rather than precise numeric. Fuzzy logic (triangular fuzzy numbers, trapezoidal, etc.) makes it possible to model such vagueness and capture uncertainty or hesitation.

The combination of Fuzzy, DEMATEL is: using fuzzy measurements for pairwise relations, then performing DEMATEL steps with fuzzified values; maybe defuzzifying, calculating the threshold, and generating causal diagrams.

Steps usually consist of the following: factors identification; linguistic scales definition; expert input collection; fuzzification; direct influence matrix building; normalization; total relation matrix calculating; “prominence” (sum of row + column) and “relation difference” (row minus column) computing; cause and effect groups dividing; mapping; insignificant relationships filtering by thresholding.

Result: CSFs ranking, root (cause) CSFs identification, interdependencies visualization, influence direction.

II. Literature Review

Fuzzy, DEMATEL has been widely mentioned in the literature in various application areas such as fintech adoption, rural agritech, and supply chain management. Here are some related works:

- Identifying and Ranking the CSFs of Fintech Adoption: Hamzah Al, Mawali et al. employed fuzzy DEMATEL to define the related critical success factors of technological innovation in the financial sector and visualized the cause/effect relationship among them.

- New technology adoption in rural areas in India (rainwater harvesting systems): This work focused on finding CSFs for rural acceptance of rainwater harvesting, applying Fuzzy, Delphi + D, DMATEL. The main factors detected were awareness, perceived usefulness, ease of use and tax incentives.
- ICT / cloud computing adoption in education in developing countries: A study on cloud computing in education (India) came up with 17 factors; the main ones being learning skills & attitude, lack of infrastructure, learners' ability, investment, etc.
- Supply chain / Knowledge management adoption: Fuzzy DEMATEL has been used to reveal CSFs in Indian automotive SC like support from the top management, employee training and smooth flow of information through integration of technology.
- These studies let us generalize a few points:
- The majority of cause group CSFs are related to such aspects as organizational / institutional support (leadership, management commitment, training) along with infrastructural readiness.
- The effect group CSFs are those which are more downstream / outcomes or influenced by others like usage, client satisfaction, cost savings, etc.
- Infrastructure, awareness, and skills have been highlighted as the main building blocks of rural / low, resource areas in most of the research works.

III. Methodology

To apply a Fuzzy-DEMATEL CSF analysis for CIFCL's rural branches, one would proceed along the following lines.

Identification of Candidate CSFs for CIFCL's Rural Branches

To understand the root causes of the problems we could begin with:

- Liting of the most important exisiting studies and drawing on all related subjects as microfinance, fintech in rural areas, etc.
- Organizing interviews and focusworks with senior Executives of CIFCL, branch staffs and clients (rural clients) in order to get their views on barrier and enabler.
- Furthermore, the use of Delphi techniques could be for refining and validating candidate list.

Candidate CSFs might be:

- Infrastructure readiness (power, internet, hardware)
- Staff capacity & training
- Leadership / management support
- Client digital literacy / awareness
- Trust, security, data privacy
- Cost / affordability (for CIFCL and clients)
- Local culture / social norms / gender issues
- Regulatory / policy environment
- Maintenance, after sales support, technical support
- Product fit / relevance to rural needs
- Ease of use of technology / user interface design
- Financial incentives / subsidy / economic benefit to clients

The above list is only to give an idea about the factors that would be verified through the CIFCL case study.

Expert selection, data collection, linguistic scales, fuzzification

- Expert selection: find people who know how CIFCL works in rural branches: branch managers, IT staff, clients, external experts in rural development / financial inclusion. Enough to provide different points of view.
- Data collection: through pair wise comparisons: each expert is asked, for each pair of factors (CSFi, CSFj), how much CSFi influences CSFj (linguistic scale: e.g. No influence / Very low / Low / Medium / High / Very high).

- Linguistic scale: make each of them very clear, map to fuzzy numbers (for example triangular fuzzy numbers: “Low” = (0.1, 0.3, 0.5), “Medium” = (0.4, 0.6, 0.8), etc.).
- Fuzzification: convert the linguistic assessments into fuzzy numbers, maybe combine them into one using fuzzy aggregation methods, maybe use weighted average if some experts have more knowledge of the domain.

Building Direct Influence Matrices, Normalization, Computing Total Influence, Thresholding

- Construct the fuzzy direct influence matrix (fuzzy values of influence of i on j).
- Normalize the matrix so that the maximum sum of row or column is less than or equal to 1 (or any other normalization method).
- Calculate total relation matrix: a matrix that reflects not only the direct but also the indirect relations: through a power series of normalized matrix, etc.
- For each factor find Prominence (sum of row + column: a factor that is highly connected with the others) and Relation Difference (row minus column: a factor that can be either a net cause or a net effect).
- Determine a threshold (it may be derived from the average of the entries or by using other statistical methods) for disregarding the weak influence paths in the interrelation map.
- Display the cause effect diagram: show arrows from cause factors to effect factors, the strength of relations represented by the thickness of arrows.
- CSFs can be ranked using prominence or other combined measures of importance and causal centrality.

Potential Critical Success Factors for CIFCL Rural Branches

The set of Critical Success Factors (CSFs) that are possible, along with their relationships and probable cause, effect groups as per the CIFCL rural branches context and the literature are shown here. Firstly, these need to be confirmed by an empirical study using Fuzzy DEMATEL for CIFCL but serve as a helpful initial conjecture.

CSF - Description

- Infrastructure Readiness - Stable electricity, good internet connection, hardware (computers, mobile devices), physical branch facilities.
- Leadership & Management Support - Commitment of senior management, the readiness to allocate resources, supportive policy by organization leadership.
- Staff Capacity & Training - Branch staff skills in technology use, change management, digital tools, client support.
- Client Digital Literacy & Awareness - Knowledge of clients regarding technology, being aware of its advantages, and being willing/able to use tech tools.
- Trust, Security, Data Privacy - Client and staff trust in security, protection of personal information, and technology reliability.
- Cost / Affordability - The cost for CIFCL to buy and maintain technology; the cost burden on clients (fees, devices, connectivity).
- Product Fit / Relevance - The technology can effectively meet rural client needs; it is adapted to local language, culture, and usage patterns.
- Ease of Use / User Interface - UX User, friendly interfaces, minimal technical complexity; staff and client convenience.
- Technical Support & Maintenance - Regular support, repair, updates, etc.; ability to assist when things are broken.
- Regulatory / Policy Environment - Government regulations, compliance, subsidies, licensing, fintech rules, etc.
- Social & Cultural Norms - Gender dynamics, social trust, local norms about financial services and technology use.
- Incentives & Economic Benefit - Clients getting real benefits (cost savings, time savings, increased income) and maybe incentives/subsidies from the government or the organization.

Hypothesized Interrelations: Cause vs Effect

- Likely Cause Group CSFs (the factors from which many others are influenced):
 - Leadership & Management Support

- Infrastructure Readiness
- Staff Capacity & Training
- Regulatory / Policy Environment
- Likely Effect Group CSFs (the factors that are more downstream, influenced by others):
- Ease of Use
- Client Digital Literacy & Awareness
- Product Fit / Relevance
- Trust, Security
- Incentives & Economic Benefit
- Some CSFs like Cost/Affordability, Technical Support & Maintenance may be considered as having dually roles (both cause and effect depending on the context). For instance, high costs may lead to a decrease in infrastructure investment; low, cost technology may rely on leadership and/or economies of scale.
- Visualization of interrelations of relationships may depict arrows such as:
 - Leadership & Management Support → Staff Capacity & Training
 - Infrastructure Readiness → Ease of Use; Infrastructure → Cost / Affordability
 - Regulatory / Policy Environment → Cost; also → Product Fit (via enabling policies)
 - Staff Capacity & Training → Client Digital Literacy & Awareness
 - Product Fit & Relevance → Client Trust
 - Client Awareness → Adoption (which could be considered ultimate outcome, maybe effect group)

Case Implications

Considering the CIFCL rural branches CSFs (Critical Success Factors) and their mutual dependencies are a few practical implications:

Address Root Causes First

- Concentrate your energy on those areas which are related to the core group of Leadership & Management Support; Infrastructure Readiness; Regulatory / Policy Environment; Staff Capacity & Training.
- A good example of this is probably when the head office having a solid commitment (budget, strategic priority) for rural tech adoption becomes most important. In the absence of that, other processes could just be short, lived.

Invest in Infrastructure & Technical Support

- A few examples are power backup to be more dependable, connectivity solutions (such as satellite, mobile broadband, etc.) and hardware procurement policies.
- Implementation of the processes for maintenance and support (involving the local technicians and remote monitoring) to be done.

Training and Change Management

- It is not simply the training in the usage of the tools but also the building of the digital mindset, handling the opposition to the change, doing the capacity building on a continual basis.
- The training given to staff for them to be not only the coach / helper but also the client since the digital skills of clients will determine how fast the digital tools are adopted.

Client Engagement: Awareness & Trust

- One of the ways to do so is through communication campaigns, demonstrations, and pilot projects which can be implemented to raise awareness.
- Making sure that security & privacy is taken care of in a transparent way to build up trust.

Design & Product Fit

- Adjust technology to the needs of the locals that is to their language, user, friendliness, and connectivity limitation. Go for the lightweight apps and offline modes.

Cost & Affordability Strategies

- Try various options such as subsidized models, collaborations, getting devices or models at a lower price (bring your own device, shared devices), and cost recovery if it is possible.
- Make use of the economies of scale and open, source tools to lower the cost of licensing.

Policy and Regulatory Advocacy

- Have a word with the regulators in order that the obstacles (licenses, compliance, etc.) are lessened so that digital finance can flow free and subsidies or tax incentives are easily attainable.

Monitoring & Feedback Loops

- Use Fuzzy DEMATEL or nature similar periodically to revalidate CSFs and monitor whether causes are addressed and effects improving.

Challenges, Limitations and Research Gaps

- Data limitations: Experts' judgments can be subjective and biased; small sample sizes may have a significant effect on the results.
- Context specificity: A successful approach in one rural area might fail in another; the influence of culture, geography, and economy.
- Dynamic change: Time goes by with technology and context changing accordingly; infrastructure gets better, regulations change, etc. Therefore, CSFs may also become different.
- Interdependency complexity: Some factors are so deeply connected that they influence each other through feedback loops; although fuzzy DEMATEL is a great tool, there is still the possibility of oversimplifying the situation.
- Cost of implementation: The even situation when the CSFs are discovered, putting them into practice is usually (especially infrastructure or regulatory change) a costly affair and beyond branch level control sometimes.
- Measurement of outcomes: It is very crucial to link CSFs to the actual adoption and usage, rather than just readiness or attitudes.
- Gap in literature: There are very few studies that focus solely on microfinance branches such as CIFCL; not much published data particular to rural finance branches that have simultaneously adopted operational and client, facing technology (back office + front office).

IV. Conclusion

The process of implementing technology in the rural branches of financial institutions such as CIFCL is a complicated one and greatly depends on various success factors. The Fuzzy DEMATEL is a powerful instrument for not only identifying the most significant factors but also for revealing the causal interrelationships of the factors under uncertainty. As for CIFCL, the leading or cause CSFs are going to be a combination of leadership/management support, infrastructure readiness, staff capacity, and the regulatory environment enabling. How the root causes are addressed will determine the extent of downstream effects such as client awareness, ease of use, product fit, and trust.

The creation of a Fuzzy DEMATEL study specific to CIFCL will facilitate prioritization based on data, driven grounds thus allowing a more effective distribution of resources. The approach, however, is not without its difficulties, such as cost, subjectivity, and changing situations, yet it provides a systematic method for dealing with complexity, concentrating on strategic investments, and following up on progress over time.

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