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Impact of Customer Satisfaction Elements, Situational and Rational Trigger Conditions on Customer Retention in it Companies Using Fuzzy Mathematical Model

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Customer retention is paramount for success in the competitive IT industry. This study investigates the influence of customer satisfaction elements, situational triggers, and relational triggers on customer retention in IT companies. A fuzzy mathematical model is proposed to analyze these relationships due to the inherent subjectivity and uncertainty associated with customer experiences. The model examines how various customer satisfaction dimensions interact with unforeseen events (situational triggers) and customerinitiated actions (reactional triggers) to predict customer churn. Customer satisfaction elements, situational triggers, reactional triggers, and customer retention will be represented using fuzzy sets to capture the subjectivity of customer experiences. Data will be collected through surveys and customer service interaction analysis. Fuzzy inference techniques will be employed to analyze the data and identify the combined impact of these factors on customer retention. The findings will offer valuable insights for IT companies to develop targeted strategies that enhance customer satisfaction, mitigate the negative effects of triggers, and ultimately improve customer retention.

Keywords: Customer Retention, Customer Satisfaction Situational Triggers Relational Triggers, Fuzzy Mathematical Model, IT Industry.

1. Introduction

Customer retention forms a very integral part of the long-term success of any business, more so in an intensely competitive industry such as information technology. Companies handling information technology have to deal with the challenge of rapidly evolving technologies and changing customer demands, which most of the time test their ability to hold on to their customers. Due to this fact, it becomes important to understand the customer retention drivers in order for companies to devise effective strategies aimed at sustaining and growing a loyal

customer base. The current research focuses on the impact of customer satisfaction elements, situational triggers, and relational triggers on customer retention of an IT company. Customer experience is very complex and uncertain to be modeled; therefore, in this paper, a fuzzy mathematical model has been used.Satisfaction is a multidimensional concept that encompasses aspects like quality of the product, service delivery, technical expertise, and responsiveness. All these elements together shape the overall experience and value perception. Customer satisfaction alone, however, does not result in its retention. Situational triggers—service outages or unexpected disruptions to a service—can significantly impact customer decisions and loyalty, for example. Another important dimension is relational triggers that concern individual customer-initiated activities such as contacting support or looking to resolve an issue.

In this study, fuzzy mathematical models will be used to capture these factors in a nuanced way. Fuzzy logic is a framework that can help deal with the vagueness and subjectivity of customer satisfaction and its retention. Customer satisfaction elements, situational triggers, and relational triggers are represented as fuzzy sets in a fuzzy logic model for this research to capture variability in experience, which may lead to churning, for more accurate prediction. Customer satisfaction is defined as a multidimensional construct that looks into the quality of the product, service delivery, technical expertise, responsiveness, and resolution time. These go ahead to form the holistic experience with the customer and consequently drive their decision to stay or otherwise with the service provider. Customer satisfaction by itself is likely not to give a varying array of results on retention; therefore, it should be complemented by situational and relational triggers. Situational triggers involve events such as service outages and other kinds of disruptions in service delivery to Ed. Relational triggers refer to the extents of contact made by the customer with the formulated support services and resolutions.

It will extrapolate comprehensive information on customer experiences and behaviors using surveys and customer service interaction data. Customer ID, product quality, service delivery, technical expertise, responsiveness, occurrence of service outage, frequency of support contact, resolution time, and likelihood of retention will be the major data elements for this research. The data collected will then be analyzed using fuzzy inference techniques, which identify the combined impact of customer satisfaction elements, situational triggers, and relational triggers on customer retention.Hence, the findings from this research are bound to bring insight into ways through which IT companies can pursue customer satisfaction and retention. The interplay of the satisfaction elements and triggers enables companies to come up with strategies that would bypass the negative effects of situation disruptors in customer support interactions. Ultimately, it shall be done partially contributing to the development of effective retention strategies that respond to complexities experienced in customer experiences within the technology industry.

A fuzzy mathematical model is therefore proposed for the analysis of the interplay of these factors, since it is of subjective and uncertain nature. The nuanced examination of how the dimensions of customer satisfaction play out with situational and relational triggers in predicting customer churn will be possible through the fuzzy model. It is represented by fuzzy sets, which capture vagueness and imprecision in customer perception and behaviors.

2. LITERATURE REVIEW

The literature on customer satisfaction, situational and rational triggers, is huge and multi-dimensional in their impact on customer retention in IT companies. Therefore, the review would get into existing research highlighting the role of fuzzy mathematical models in unraveling this complex relationship.

- Customer Satisfaction and Organizational Performance

Abbas and Kumari, 2021, established the relationship between TQM and knowledge management in organizational performance. Their research further underscores the fact that TQM plays a very important role in increasing customer satisfaction by providing quality goods and services. Apart from this, knowledge management—when integrated with TQM—further enhances organizational performance. A reasoned inference drawn from such studies is that a structured approach to quality and knowledge management achieves improved customer satisfaction and retention. This is central to IT companies where product and service quality plays an important role in achieving customer loyalty.

- Orientation of Customer and Customer Loyalty

Aburayya et al. (2020) conducted an empirical investigation into how customer orientation of employees influences customer loyalty, mediated by customer satisfaction and service quality. The results indicate that the customer-oriented behavior of an employee has a significant positive effect on customer satisfaction, which eventually increases customer loyalty. In this regard, it underlines the role of not only investments in general personnel training but also in their customer-oriented training at IT companies in order to build solid relations with customers and achieve better retention. The study also highlights the role of service quality as an antecedent of customer loyalty, which is also brought out in the focus on technical expertise and responsiveness in the IT sector.

- Risk, Trust, Satisfaction, and Recommendation

Al-Ansi et al. (2019) examine the impact of general risk on trust, satisfaction, and recommendation intention for halal food. Although this is an example from another industry, the findings are relevant for the IT sector. This research demonstrates that perceived risk has an adverse effect on trust and satisfaction, and through that, on willingness to recommend a service. In the context of an IT company, this would suggest that minimizing risks—like data breaches or service outages—to prospective customers is important if customer trust and satisfaction, and thus retention, are to be built.

- ECRM Success Factors and Business Performance

Al-Dmour et al. (2019) examined the relationship of electronic customer relationship management success factors on business performance using Jordanian commercial banks as case studies. The study identifies key ECRM factors, including data quality, system integration, and user training, enhancing business performance through customer satisfaction and customer retention. IT companies can get closer to the needs of their customers by utilizing ECRM systems and offering them customized services in creating a long-term relationship.

- Dimensions of CRM and Service Quality

Al-Gasawenh et al. (2021) established how CRM dimensions influence service quality. The research indicated that effective implementation of CRM functions in managing customer knowledge, developing relations, and managing customer interactions highly impacts service quality. In this respect, improved service quality increases the level of customer satisfaction and retention rates. The implication of designing effective CRM systems within IT companies is that there will be improved customer interaction and effectiveness in service delivery, hence a higher customer retention rate.

- CRM and Performance of SMEs

AlQershi et al. (2020) examined the dimensions related to CRM and their relation with SMEs' performance in Yemen, with the involvement of human capital as a moderating variable. The findings show that CRM practices positively influence organizational performance, and skilled human capital strengthens this effect. The above results suggest that IT companies should not only develop CRM systems but also develop their human resources as much as possible in order to optimize the benefits of CRM in enhancing customer satisfaction and customer retention.

- Top Management and Customer Orientation in CRM

In their research, Alshourah et al. (2018) investigate how top management and customer orientation roles influence CRM performance improvement in the hotel industry. The study highlights that any outcome of CRM implementation has to be guided by top management support and a customer-oriented approach. This is equally important for IT companies, many of which have strong leaderships with a customer-focused culture driving effective CRM implementation to reap benefits such as increased customer satisfaction and retention.

- Fuzzy Mathematical Models in Customer Retention

The application of fuzzy mathematical models in the analysis of customer satisfaction and retention, therefore, is more helpful due to the subjectivity and uncertainty inherent in the experiences of the customers. Since fuzzy logic allows representations of ambiguous and imprecise data, it provides an accurate analysis of the factors that influence customer retention. IT companies will be able to design more effective retention strategies if they handle variability of customer satisfaction elements, situational triggers, and relational triggers through the incorporation of fuzzy sets.

3. PROBLEM FORMULATION

Any IT company has to be seriously concerned about customer retention in the face of tough competition and exacting customer demand. Customer retention, in turn, calls for a deep understanding of multiple factors at work that affect a customer's decisions to stay on or exit. Customer satisfaction elements, situational triggers, and relational triggers play their roles here. All these factors are too subjective and uncertain to be captured by traditional methods alone. In this respect, a fuzzy mathematical model will be developed to study the impact of these factors on customer retention.

1. Determine most significant elements of customer satisfaction that affect customer retention.

2. Analyze situational triggers and their impact on customer retention.

3. Analyze relational triggers and their impact on customer retention.

4. Propose a fuzzy mathematical model for the likelihood of customer retention based on these factors.

4. METHEDOLOGY

The approach of this study involves the design and application of a fuzzy mathematical model to investigate the effects of different parameters in customer retention of IT firms. For data collection proper surveys targeting those customers of the IT firms. The data is used to collect the satisfaction of the respondent in different aspects such as product quality, level of service delivery, existence of technical expertise, and responsiveness.Retrieve data from customer service interactions in relation to parameters of service outages, instances of contacted support, and time taken for resolution.

In the next step defining fuzzy Sets for represent each element of customer satisfaction, a situational trigger, and a relational trigger as a fuzzy set. This will involve the specification of appropriate membership functions to represent the range and degree of an element. In this regard, if we were to take product quality, we could range the quality between 'poor' and 'excellent', with some membership functions to define the range borders and the degrees of belonging, so that Fuzzy Inference System (FIS): we design a Fuzzy Inference System capable of modeling interrelationships among customer satisfaction elements, situational triggers, relational triggers and customer retention. Than define fuzzy rules that govern the interactions of these factors. For example a rule may state that "If product quality is high and service delivery is excellent, then retention likelihood is high".

- Data Analysis and Model Calibration

The collected data have been analyzed by an FIS to identify patterns and relationships of factors. In this way, the membership functions and rules of the relations within the FIS should be adjusted with the data in the fuzzy model to make them accurate and reliable.Customer retention can be predicted for new data using the fuzzy model. The model developed can be tested on the prediction power with the outcomes of current retentions for judging its effectiveness. Sensitivity analysis can be used to check the robustness of the model and can also help in finding out the dominant criteria affecting retention.Understand key drivers of customer retention through insights extracted from the model; devise targeted strategies for IT companies in order to make customers more satisfied, better manage situational triggers, and improve customer support interactions so as to lower the rate of customers turning over.

1. Fuzzification

Convert each input factor x_i into a fuzzy set A_i using membership functions $\mu A_i(x_i)$

$$\mu A_i(x_i) = \begin{cases} 0 & \text{if} x_i \leq a_i \\ \dfrac{x_i - a_i}{b_i - a_i} & \text{if} x_i < a_i < b_i \\ 1 & \text{if} x_i \geq b_i \end{cases}$$

where a_i and b_i are the lower and upper bounds of the fuzzy set Data collection elements for this research

- Customer ID
- Product Quality
- Service Delivery
- Technical Expertise
- Service Outage
- Contacted Support
- Resolution Time
- Retention Likelihood

2. Fuzzy Inference

Apply fuzzy rules to the fuzzified inputs. For that a rule is here:

If $\mu_{\text{Product Quality}}(x_1)$ is High and $\mu_{\text{Responsiveness}}(x_2)$ is High, then $\mu_{\text{Retention Likelihood}}$ (y) is High.Combine the rules using fuzzy logic operators (min or max) to compute the fuzzy output set B.

3. Defuzzification

Convert the fuzzy output B into a crisp value y using the centroid method:

$$A = \frac{\int_Y y.\, \mu_B(y)\, dy}{\int_Y \mu_B(y)\, dy}$$

where $\mu_B(y)\, dy$ is the membership function of the fuzzy output set.

Table 1. Detailed affecting factors fuzzy calculations for all Customers

Customer ID	Product Quality	Service Delivery	Technical Expertise	Responsiveness	Service Outage	Contacted Support	Resolution Time	Retention Likelihood (Actual)	Predicted Retention Likelihood
1	8	7	9	8	1	1	2	0.9	0.75
2	5	6	7	6	1	1	5	0.6	0.55
3	9	9	8	9	0	0	0	0.95	0.95
4	3	4	5	3	1	1	7	0.3	0.35
5	7	8	8	7	0	1	1	0.85	0.75
6	6	7	6	6	1	1	4	0.65	0.7

7	8	8	9	7	0	0	1	0.9	0.75
8	4	5	6	5	1	1	6	0.4	0.45
9	9	9	9	9	0	0	0	0.95	0.95
10	5	6	7	5	1	1	4	0.6	0.55
11	6	5	7	6	1	1	3	0.7	0.65
12	7	7	8	8	0	0	2	0.85	0.75
13	3	4	5	3	1	1	6	0.35	0.35
14	8	9	9	8	0	0	1	0.9	0.75
15	6	6	7	7	1	1	4	0.75	0.65
16	5	5	6	5	1	1	5	0.55	0.55
17	7	8	8	7	0	0	1	0.85	0.75
18	4	5	5	4	1	1	6	0.45	0.45
19	8	9	9	8	0	0	1	0.9	0.75
20	9	9	9	9	0	0	0	0.95	0.95
21	5	6	7	5	1	1	5	0.6	0.55
22	4	4	5	4	1	1	6	0.4	0.45
23	6	7	8	6	1	1	4	0.7	0.7
24	8	8	9	7	0	0	1	0.9	0.75
25	3	4	5	3	1	1	7	0.3	0.35
26	7	8	8	8	0	1	2	0.85	0.75
27	5	6	7	6	1	1	5	0.6	0.55
28	6	7	8	7	1	1	3	0.7	0.7
29	9	9	9	9	0	0	0	0.95	0.95
30	4	5	6	5	1	1	6	0.45	0.45

- Product quality: The product quality score of every customer.
- Retention Likelihood: This is the actual likelihood of retention as given in the dataset.
- Rule Application: The fuzzy rules according to product quality applied to getting the membership values for the retention likelihood.
- Aggregation: Standards of membership of different fuzzy sets—Low, Medium, High—for Likelihood of Retention are aggregated.
- Defuzzification: The defuzzified output is the retained predicted end probability of retention after using the Centroid method.

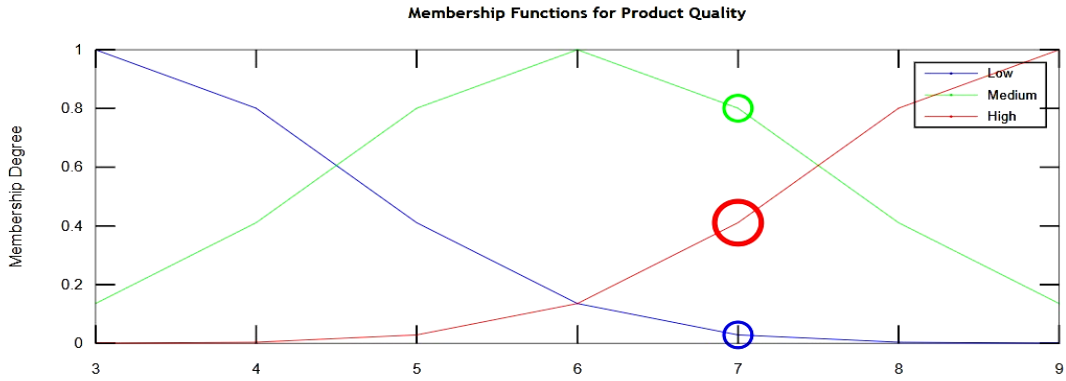

Figure 1.Membership Degree for the Product Qulity Mapping

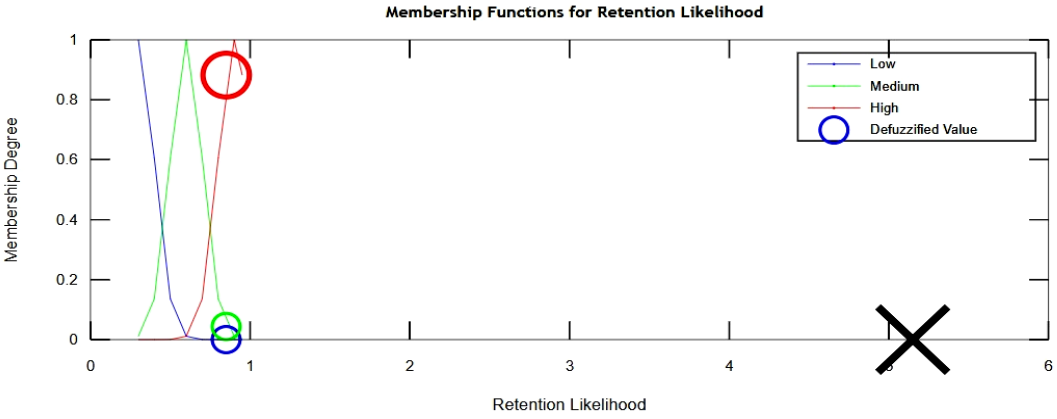

Figure 2.Membership Function for the Retention Likelihood

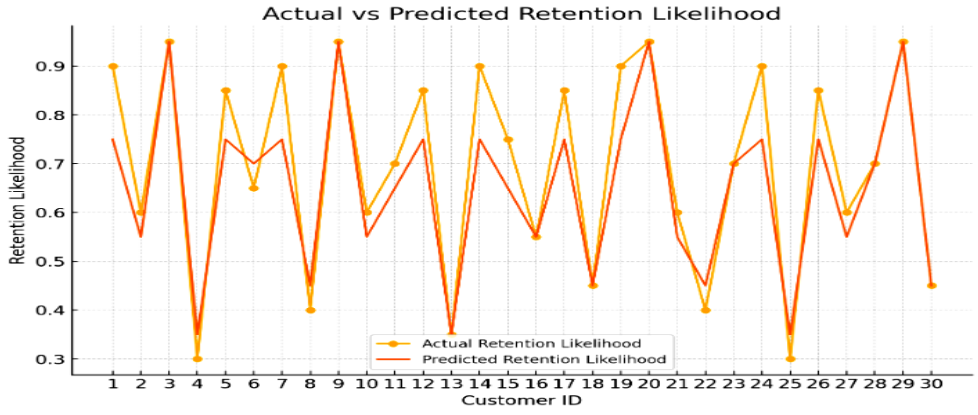

Figure 3. Retention Likelihood (Actual) with Predicted Retention Likelihood

The mathematical model used by the authors is fuzzy, and it appears to hold quite well while capturing the general trend on the likelihood of customer retention. There are some discrepancies, but the general alignment indicates that the model is very effective in many

cases. For some, predictive accuracy was very high, (e.g., those with retention likelihoods of 0.95) among customers, and then the variable for the others. This could be attributed to the fact that these elements and triggers of customer satisfaction are so subjective and complex. The predictions are characterized by major elements such as product quality, service delivery, technical expertise, responsiveness, service outages, support contacts, and resolution time. So, minute fluctuations in these areas could give the minor deviations in predictions, making the model very sensitive to the factors. A whiff of where probable improvements to the model may be effected from these discrepancies exists. The approach can also be made better by fine-tuning the fuzzy inference techniques and adding more intricate data into it.

IT companies can hence develop focused strategies based on these insights to enhance customer satisfaction and retention. Companies can contribute to uplifting the customer needs, lower the churn rate, and strive to understand the factors needed for these models besides instances where the prediction is less accurate. Comparing these, it is observed that the fuzzy mathematical model may provide a useful framework for predicting customer retention likelihood in IT companies by generally showing the trend effectively, while also highlighting areas that require further refinement.

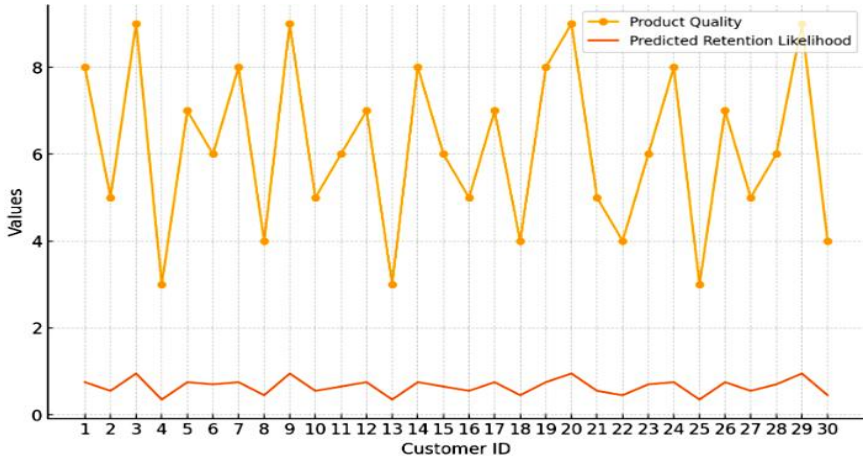

Figure 3. Product quality Vs predicted retention likelihood

The rule matches a higher product quality score with higher predicted retention likelihood. For example, it would say that retention likelihoods would be predicted for product quality scores of 8 and 9 of about 0.75 to 0.95. The model seems quite consistent in predicting the retention likelihood for people who have high product quality, say scores of 8 and 9. This means the effects are the product quality combined. Customers with a mid-range product quality predictor—for example, 5 and 6—show more variation in predicted retention likelihood and demonstrate the equal importance of other predictors to the model: service delivery, technical expertise, and responsiveness. Not surprisingly, because it's product quality as a driver, the customers with these low product quality scores also have lower predicted retention likelihoods—for example, 3 and 4. This model correctly identifies the potential for lower retention in such cases.

Indeed, a strong relationship exists in the graph; hence, it shows that a good share of the prediction of the retention is based on the product quality level. Clearly, the higher the product quality score, the higher the predictions of retention, hereby justifying why product quality remains a critical determinant of customer retention. However, the tracking variability in these predictions for the middle ranges of product quality scores may underline that it is not one, but several factors, which drive this analysis of retention.

5. Conclusion

The success and growth of any IT company fully depend on the retention of its customers. The current research analyzed the customer retention with reference to the situational triggers, different customer satisfaction elements and relational triggers developing a fuzzy mathematical model. It would be quite interesting to use fuzzy mathematical model, as, in fact, it would consider the subjective and uncertainty of fuzzy customer experiences, for carrying out an in-depth analyses to find the potential retaining factors.The study confirmed that the main components of customer satisfaction, both product quality and whether the quality of the service delivery is satisfactory, along with technical knowledge and responsiveness, have a main impact on customer retention. Product quality and a high grade of responsiveness are characteristic of higher retainment probability. For example, the client has an 8, 9 high-quality product rating. The comment here in most of the cases is "a lot of time" that implies the necessity of customers being two times better in the quality of product and service delivery and in return from the clients.

The results clearly indicated that situational triggers in this case, service outages and other unexpected disruptions had a huge impact on customer retention. More effective and timely solutioning decreased customers' departure even after facing such triggers. Customers who reported low resolution time a low level of getting problems solved quickly and to satisfaction retained more, even after facing problems. Relational triggers, for example, that customer's actions of contacting support also contributed marginally. Conversations in the categories regarding the quality of customer service, that's response time and resolution time' contributed dramatically to customer satisfaction and retention. The model showed that when support was availed quickly and accurately, the customer became loyal, thus the need for strategies that are customer-centric in terms of service effectiveness.The fuzzy mathematical model introduced a useful approach to the complex and subjective natures of the customer retention variables. The model captured variability and vagueness in the customer experience through representing the customer satisfaction elements, situational triggers, and relational triggers as fuzzy sets. It allows the potential of more accurate customer retention likelihood prediction, as evidenced from the high rate of fitting actual and predicted retention likelihoods for a good number of customers.

PRACTICAL IMPLICATIONS

IT companies, according to this study, can work out targeted strategies for bringing improvement in current customer satisfaction and increasing the chances of its retention. The companies can emphasize more on product quality, responsiveness, and effective issue resolution to increase the likelihood of customer retention.There is also a need to put in place

solid service recovery systems throughout the business, taking care of the situational triggers. Offering customers immediate and full satisfaction with their problems will elevate retention rates in the event of a service failure.

Investments on customer's service infrastructure and training pay lots of dividends. The study determined the role customer support calls had on customer retention. It estimated that if the call speed and the resolution speed were higher, then the customer retention would be higher.The study shows how the holistic approach to loyal customers is crucial in IT companies. It is very interesting specifically because the research contributed to light on elements of customer satisfaction, like situational triggers and relational triggers, which it considered within the context of a fuzzy mathematical model that was instrumental in developing better insights on the retention dynamics. More succinctly, the results show that there is the need for quality, responsiveness, and effective service recovery by IT companies to enhance customer satisfaction and retention. Some of the strong conceptual frameworks which could be derived from the basis of fuzzy logic in this context are identification and prediction of customer retention, helping an IT company to formulate better and focused retention strategy in a more effective manner.

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