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Decision analysis for selecting payment gateway and CRM system for small and medium-sized enterprises

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Declaration

We, Aiym Muratova, Aidana Sharipbay, Diana Kadyrbayeva, Khyzyrbanu Imanberdiyeva, Nurdaulet Sharipkhan, declare that the research contained in this thesis, unless otherwise formally indicated within the text, is the author's original work. The thesis has not been previously submitted to this or any other university for a degree and does not incorporate any material already submitted for a degree.

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Abstract

The selection of customer relationship management (CRM) systems and payment gateways has been recognized to significantly impact the financial and operational performance of small and medium-sized enterprises (SMEs). This study develops a decision analysis for technology selection for SMEs, focusing on payment gateways and CRM systems.

A single-attribute utility function for payment gateway selection evaluates 12 alternatives based on cost-saving, considering transaction fees, fixed costs, and monthly expenses. A multiattribute utility function assesses 9 CRM systems using both cost savings and lead conversion rates. The best alternatives for both payment and CRM are recommended for the decision maker considering his preferences, risk attitude and company size.

For business owners, this research offers a novel application of MAU theory for decision analysis, which can be adapted with data from their businesses. Scalability of the model also allows further extension with additional attributes and/or alternatives.

Keywords: Decision analysis, Payment gateway systems, CRM systems, Utility function, Single attribute, Multi attribute, Evaluation of alternatives, Decision tree.

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

SME	Small and Medium-sized Enterprises
CRM	Customer Relationship Management
TLS	Transport Layer Security
SSL	Secure Sockets Layer
PCI DSS	Payment Card Industry Data Security Standard
AHP	Analytic Hierarchy Process
LFPP	Logarithmic Fuzzy Preference Programming
FAHP	Fuzzy Analytic Hierarchy Process
MAU	Multiattribute Utility
DM	Decision Maker
4PL	4-parameter logistic

1. Introduction

Small and medium-sized enterprises(SMEs) is mostly allocated in highly competitive markets where they must establish and maintain efficient customer relationships. According to the Codeless Platforms [1], small and medium-sized enterprises use Customer Relationship Management (CRM) systems as indispensable tools to centralize customer data and streamline sales processes and improve communication with leads and existing clients.

Codeless Platforms [1] and Lemlist [2] states that SMEs can benefit from CRM solutions because they provide contact management and sales pipeline tracking and marketing automation capabilities and business tool integration at a lower cost and with greater flexibility than enterprise-level systems. CRM systems optimize sales operations through automation while providing precise sales forecasting and opportunity tracking across the entire sales cycle. At the same time OMR Reviews [3] elaborates on the integration between CRM and payment gateway systems allowing SMEs to provide seamless customer experiences while maintaining tight control over their sales processes and financial operations which requires critical analysis for their continued success.

Payment gateways act as intermediaries between merchants and financial institutions, facilitating secure and efficient transaction processing. Stripe [4] and Oyekola [5] supported the verification of payment details, confirmed transactions, and allowed funds to be transferred from customers to merchants. Therefore, selecting a payment gateway had a big significance to consider transaction fee as an attribute.

However, Casals [6] and Apasrawirote [7] stated SMEs also encountered challenges such as inconsistent service quality, complexities in system integration, and the necessity for ongoing updates and maintenance. Tackling these challenges requires a strategic approach to select and implement the right solutions, ensuring they align with the business's goals, which has been done during our literature review and further steps of development of mathematical models.

This paper provides a decision analysis model that will be used to systematically evaluate the best CRM system and payment gateway for SMEs. Evaluating critical decision criteria such as conversion rate and cost savings against scalability of the framework provides analytical methods the capability to engage in a structured comparison of alternatives. The use of decision tree analysis is able to provide qualitative analysis for identifying the best CRM and payment gateway solutions suitable for SME business requirements.

2. Literature Review

2.1. Online Payment Gateways

An online payment gateway is a technology platform that bridges buyers (customers) and sellers (businesses) in electronic financial transactions. It is provided by e-commerce application services and enables online businesses to accept, process, and manage various payment methods from customers — such as credit cards, debit cards, and digital wallets — securely and efficiently. Payment gateway is the most relevant digital tool that can make online and distant payments easier and more accurate as it eliminates extra actions that take place in e-commerce such as contacting banks, transaction systems, etc., during each transaction from bank to bank. It is used for payments in online closing, grocery, electronic, and other sectors. One of the areas it can be implemented is IT academy [8]. Usually, IT courses are sold online, enabling payment processing via payment gateway services.

The working principle of payment gateways consists of several steps [9, 10]. The first step starts with the initiation of the transaction, where the customer chooses items or services on the merchant's website or mobile app and proceeds to the checkout window. Credit card or digital wallet details are typed into this window to place an order. The second step is payment data encryption, where the payment gateway encrypts payment information immediately using Transport Layer Security (TLS) or Secure Sockets Layer (SSL) encryption protocols that ensure the protection of the data against unauthorized access [9]. In the third and fourth steps, encrypted data is transmitted to the payment gateway processing in secure order once the data is sent to the server of the business, and this encrypted data is forwarded to the appropriate payment network and acquiring banks by the payment gateway, respectively [10]. The fifth step is transaction verification, where the merchant's bank sends an authorization request to the issuing bank to verify details such as account balance info and the validity of the payment method. Then, the transaction is approved or declined by the customer's bank based on verification in the pre-last step. In the final step, the payment gateway sends this response (transaction status: approved or declined) to the merchant's website or app with the appropriate message for the customer as well. When approved, the merchant proceeds with order fulfillment.

The global e-commerce market is predicted to total over $7.9 trillion by 2027, and it is the best and most beneficial time to join e-commerce [11]. Hidajat and Salini indicate seven main benefits of using payment gateways for online payments [12]:

- Faster Payment - Payment gateways can initiate easier and faster-to-process translation activities, so there is no need to confirm every incoming transaction manually for businesses and create a single platform to track online incoming payments.
- More Payment Options - Businesses can provide a wide range of payment acceptance methods to their customers, while providing only one bank account to a payment gateway provider to receive incoming transactions. This eliminates limitations in payment options and gives flexibility, ensuring high customer satisfaction and increasing sales.
- Wider reach - Given that consumers can choose the method they prefer and conduct transactions at any time and from any location, an online business can increase its market reach by integrating multiple payment methods. Additionally, the expansion of the Internet enabled a rise in incoming transactions.
- No need for multiple accounts - Merchants do not need to provide all their bank accounts or open new ones (in addition to digital wallets, etc). With just one integration, payment gateways allow them to connect automatically with almost all banks in the world.
- Security Guaranteed - Payment gateways employ encryption to protect private data, including credit card numbers, throughout the data transfer process, which helps to prevent data theft. Payment gateways are equipped with fraud detection systems to spot suspicious transactions and provide warnings to cardholders or online business owners. Also, strict security standards like having the “Payment Card Industry Data Security Standard (PCI DSS)” certification must be met by payment gateways. This guarantees that the payment gateway can implement the relevant security measures to address security problems like data leaks.

Due to its gaining popularity, there are many payment gateway providers today. There are a lot of factors to consider when choosing the right gateway provider for the business such as the cost of the service (fixed fees, transaction fees, monthly fees, maintenance fees, etc.), types of cards and payment methods allowed, transaction holding time, multiple currency support, option for recurring billing (subscription or auto charges), hosted or non-hosted modes of hosting payment gateways, mobile payment support, integration with other systems, limitations, and security [13]. It may be crucial for businesses, depending on their size, to choose the right gateway service provider.

The selection of an appropriate payment gateway can be made using different approaches. Ramakrishnan and Lakshmi did a tabular analysis of five payment gateway

providers in order to get a comprehensive insight into the key features, strengths, and weaknesses by assessing their offers, integration opportunities, security levels and measures, costs, and client support [14]. Data for the analysis was taken from open sources.

On the other hand, Rajdeep, Sharma, and Mittal gained data not only from secondary sources (magazines, journals, scientific papers, articles, etc.) but also from primary sources of data collection. They used an online survey/poll with the questions created in advance. Then, the answers of respondents were analyzed in the form of pie charts in combination with the information from secondary sources to check whether their initial hypothesis about the optimal payment gateway provider, which is Amazon Pay in this case, was accepted or not [15].

Lowry et al. evaluated the existing literature and provided real-time information for the researchers and companies focused on e-commerce [16]. They studied the components of online payment systems (traditional, one-to-one, and third-party) and explained how a single transaction processing works. They have chosen several leaders who provide payment gateway services and briefly analyzed their strong and weak sides. Based on their analysis, guidelines for selecting an online payment gateway company were provided (a table that contains a list of questions to be considered during the selection process and an explanation of the importance of each question).

In another research, a local study (Thailand) was conducted to identify the variables that impact payment gateway selection for online purchases [17]. Quantitative data was collected and analyzed for this research: 1635 respondents were involved in the collection of the data in the form of closed-ended questionnaires that were distributed through social media. Then the data was analyzed using statistical analysis software and a binary logistics regression approach (meaning that the values for dependent variables were set to 0 and 1) to investigate the relationship between dependent and independent variables. The results revealed that demographic factors such as gender, age, and income are important factors that affect consumers' buying decisions. There were also factors such as social presence, trust, perceived risk, perceived ease of use, attitude towards using, and consumption that directly affected consumers' decisions.

Non-Probability Sampling-Purposive Sampling technique is used in the study conducted by Isanawikrama et al [18]. This method implies choosing based on criteria under one problem or topic. In this case criteria was in the scope of "payment gateways in Indonesia" and 205 respondents were involved in data collection with this sampling. The data was analyzed using the Path Analysis Method with computer programs. The research

proves the perceived usefulness of online payment gateways in purchase intention and online buying behavior of customers [18].

2.2. CRM Systems

There are several research works investigating buyer-seller relationships and communication methods in the digital era. It is found that CRM tools integrated to the company's buyer-seller relationship positively affects customer knowledge, satisfaction and loyalty, which adds value to company's profitability [19, 20]. The benefits of integrating CRM systems to the organization is beneficial, but selecting the right software package is challenging in a market full of different offerings. Due to the significant degree of uncertainty in the business world, evaluating a CRM functionalities and features must be based on specific needs of businesses. However, many businesses implement CRM systems without fully understanding the implications for their operations and without any confirmation that chosen CRM aligns with all corporate objectives and strategies [21]. There are some efforts made to make a decision analysis framework to facilitate companies to choose the best software package.

Colombo and Francalanci [22] used a hierarchical ranking framework to classify 42 CRM systems based on functional, financial and technical quality criteria. A smaller sample size of promising CRM systems selected using Analytic Hierarchy Process (AHP), but no quantitative measure is used to rank CRM systems. The authors acknowledged that their model does not select the one CRM software for a business, but supports to preselect possible alternatives for further deeper analysis [22].

Lee et al. [23] developed a decision analysis model based on AHP to select open source CRM systems specifically for SMEs. Three IT specialists are considered as the main decision makers and the approach covered functional and organizational attributes. While the model offers a structured framework to evaluate open source software, a hierarchical decision tree has notable limitations in terms of adaptability. The decision tree is designed only for a predefined number of evaluation criteria and cannot be expanded. Moreover there are only three CRM alternatives and the model is fixed, which restricts addition of new alternative options. These drawbacks significantly limit its applicability across different business environments [23].

Cricelli et al. [24] develop a four-step framework for cost-benefit analysis, which involves the usage of AHP and its fuzzy adaptation (i) analyzing the firm, (ii) choosing the set of criteria, (iii) CRM prescreening, and (iv) choosing the CRM are the steps proposed in the framework. The cost-benefit analysis is made using different mathematical approaches and tools. Logarithmic Fuzzy Preference Programming (LFPP) method implies

logarithmic nonlinear programming with Solver tool. Fuzzy Analytic Hierarchy Process (FAHP) is the extension of AHP, in which pairwise comparison is translated into fuzzy numbers. Authors showed that the combination of AHP and FAHP methods not only identify important criteria and set of possible alternatives but also helps to select the best CRM option. The model is tested in a real-life company and models' adaptability is proven. However, the model is designed to be led by CRM experts, not by decision makers autonomously [24].

Oyekola and Xu [25] implemented AHP approach to conduct cost-benefit analysis to a small private company. The framework is developed specifically for this company and cannot be generalized, however other researchers/decision makers may adapt the model and customize it [25].

Other studies are focused on collecting selection criteria to CRM and classifying these systems [26, 27]. From literature review it is found that there is a significant research gap in developing a flexible, scalable and adaptable decision-analysis framework for CRM selection. There is a need to develop a model that can be easily used by decision makers, cover specific needs of SMEs, and support adaptability to new criteria and alternatives.

2.3. Multiattribute Utility (MAU) Theory

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3. Methodology

3.1. Description of the problem

The decision maker is the owner of an IT academy offering 6-month online courses twice a year. Up to now, the academy has successfully completed two course launches with 69 and 102 students respectively. The organization made a turnover of 22.5 million KZT from the first launch and 28.5 million KZT from the second. To further improve its operations, the company has identified gaps in B2C sales and aims to eliminate by implementing CRM and payment gateway systems.

3.2. Payment Gateway

3.2.1. Alternatives

For the choice of payment gateway, we conducted a thorough review of the options available geographically to be employed in Kazakhstan. Twelve different options of payment gateways were identified and included in this study for analysis. The list of alternatives is given in Table 1.

Table 1

Payment Gateway Alternatives

Domestic Alternatives	Website	International Alternatives	Website
TipTopPay	tiptoppay.kz	Helcim	helcim.com
KaspiPos	kaspi.kz	Stripe	stripe.com
Freedom Pay	freedompay.kz	Square	squareup.com
Robokassa	robokassa.kz	HubSpot Payments	hubspot.com
Woopkassa	woopkassa.kz	Shopify Payments	shopify.com
OneVision	onevision.kz	PayPal	paypal.com

Kazakhstan's payment market is experiencing a rapid digital transformation shifting from cash payments to non-cash payments. According to a study by PwC Kazakhstan [34], in 2022 non-cash payments had a 49% increase from 2021, totaling 21.6 trillion KZT. The number of non-cash transactions also grew by 44%, reaching 3.8 billion transactions. The main reason for this growth was partly driven by the appearance of new digital solutions and the rising availability of non-cash payment options. Notably, the number of POS terminals surged by 66% compared to 2021, reaching 832,000 units [34].

There are 6 domestic payment gateways presented in Table 1.

KaspiPos by Kaspi.kz is the main player in the local payments market. For consumers, it offers a convenient way to complete shopping transactions via QR or bank card details. For merchants, the platform facilitates in-store and online payment acceptance, instant invoice issuance and settlement, supplier payments, turnover and inventory tracking, as well as tax reporting and payments. The Kaspi Shopping Register integrates a digital cash register within the Kaspi Pay Super App, seamlessly connecting with the POS network. In the first half of 2024, the platform served 721,000 merchants and 13.2 million consumers [35]. However, the main disadvantage of KaspiPos is that it requires both customer and provider to have Kaspi accounts in order to pay online as it works inside of the Kaspi.kz environment. Therefore, online payment can be made only by Kaspi.kz users.

Freedom Pay by Freedom Finance is another local payment solution catering to the Kazakhstani market. In an international market Freedom Pay owns a market share of 0.01% [36].

TipTop Pay, Robokassa, Whoopkassa, OneVision are domestic payment aggregators that provide online transactions, though detailed information about their market share is unavailable. The main advantage of these gateways is that unlike KaspiPos and Freedom Pay, these providers are not owned by a specific bank and are not bank products.

Globally recognized 6 international payment gateways are chosen and presented in Table 1. Some international payment systems were excluded because of the unavailability in Kazakhstan.

International payment gateways operate across multiple markets, each holding a varying market share. Helcim accounts for 0.01% [37], while Stripe holds 32.87% [38], and Square captures 28.02% [39]. Shopify Payments leads with 66.87% [40], followed by PayPal at 35.15% [41]. Market share data for HubSpot Payments is currently unavailable.

Each of the 12 alternatives has an equal probability of success, which is the percentage of implementing the payment gateway in the sales process. Success of the alternative is based on high (p=0.25), base (p=0.5) and low (p=0.25) chance events that correspond to high, base and low values of cost savings that each alternative can offer depending on high, base and low revenue values of the business.

3.2.2. Objectives and Attributes

The main objective of the decision maker is to maximize cost savings. The main attribute in this decision analysis is cost savings. It refers to 6 months cost savings in kazakhstani tenge (KZT) from using the best alternative. Transaction fee, fixed cost, monthly cost values for each alternative of payment gateway system were mainly collected from their official websites and case studies (see Appendix A).

3.2.3. Decision tree

There are 36 outcomes with 12 alternatives in the decision tree. The overall objective is to find the best alternative by comparing expected utility of each alternative. For this we need to (i) collect min, low, base, high, max values of transaction percentage, fixed cost and monthly fees from gateway companies for each of 12 alternatives, (ii) collect min, low, base, high, max values of average price and number of sales from the decision maker, (iii) calculate min, low, base, high, max values for total costs and then (iv) calculate corresponding cost savings, (v) evaluate the decision maker's risk attitude via questionnaire, (vi) construct the decision tree and (vii) calculate the expected utilities of each alternative, and (viii) choose the alternative with the highest expected value.

3.3. CRM Systems

3.3.1. Alternatives

For CRM software, according to Figure 1 and the PRISMA methodology, the selection process started with the identification of alternatives through available resources, such as related articles (n=11) and global statistics (n=26). The initial search provided 37 possible CRM solutions, which were then put through a screening phase. Six possibilities were eliminated based on predetermined criteria: lack of open-source data available (Criterion 1, n=6), inappropriate for the size of business in the IT academy (Criterion 2, n=5), and lack of statistical data available for analysis (Criterion 3, n=7). The remaining nine CRM systems were assessed for appropriateness and later included for analysis to determine a reduced, focused analysis on the most appropriate and viable options. The list of alternatives is given in Table 2.

Table 2

CRM Alternatives

Alternatives	Website
Bitrix24	bitrix24.com

Freshsales	freshworks.com
HubSpot	hubspot.com
Microsoft Dynamics 365 Sales	dynamics.microsoft.com
Monday CRM	monday.com
NetSuite CRM	netsuite.com
Oracle Siebel CRM	oracle.com
SuiteCRM	suitecrm.com
AmoCRM	amocrm.com

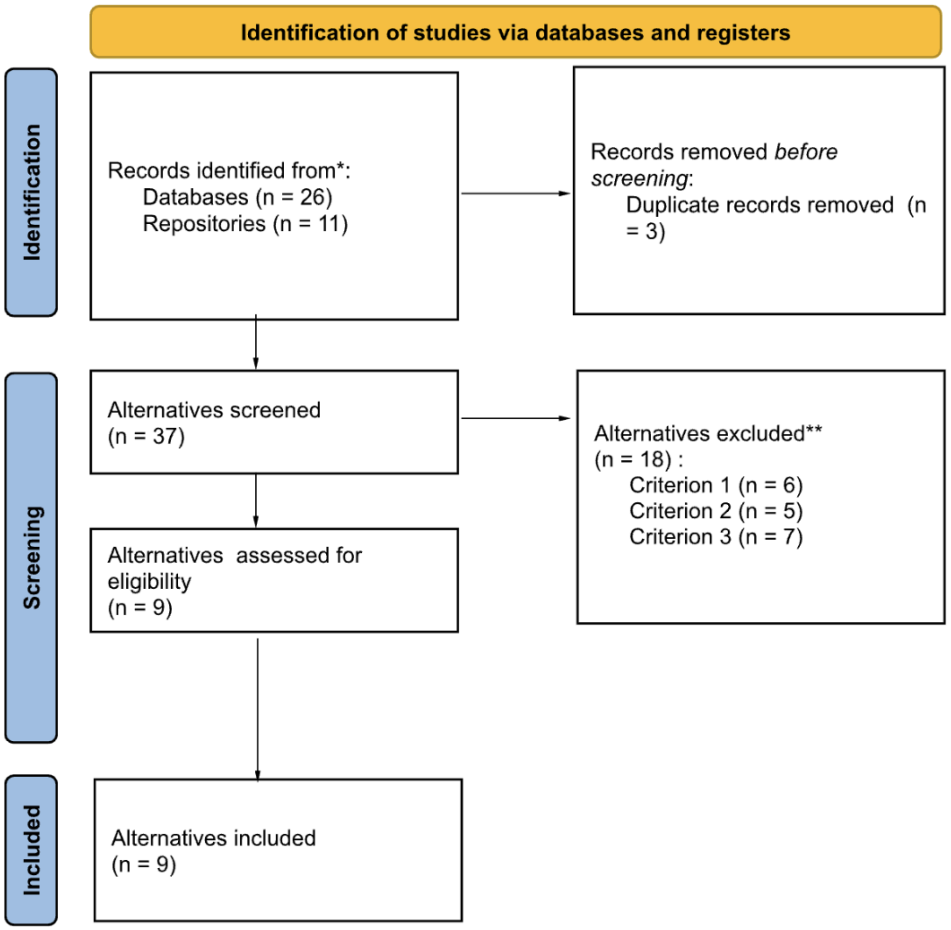


Figure 1. PRISMA: Criterions-Based Filtering

Globally recognized 9 CRM Alternatives are chosen and presented in Table 2. According to the IRCOIT [42] and Redress Compliance [43], all of them are successfully implemented and offer unique features tailored to different business sizes and needs, from SMEs to large enterprises. The chosen alternatives were selected to ensure alignment with the preferences and operational realities of the majority of stakeholders, as well as to maximize compatibility with the business's existing processes and anticipated growth, making broad applicability and ease of adoption pivotal deciding factors.

3.3.2. Objectives and Attributes

The main objective of the decision maker is to maximize cost savings and lead conversion rates. Cost savings are calculated for the first year of CRM integration. Raw data are gathered from case studies and official sources to determine various cost considerations and conversion rates. These include the initial setup cost, annual subscription fees, integration fees, training costs, and maintenance costs. All these costs and conversion rate values were mainly collected from case studies and official websites (see Appendix B).

3.3.3. Decision tree

There are 81 outcomes with 9 alternatives in the decision tree. The overall objective is to find the best alternative by comparing expected utility of each alternative. For this we need to (i) collect min, low, base, high, max values of the initial setup cost, annual subscription fees, integration fees, training costs, and maintenance costs for each 9 alternatives, (ii) identify min, low, base, high, max values of adoption rate values from the survey of company workers and conversion rate from the real cases, (iii) calculate min, low, base, high, max values for total costs, (iv) calculate corresponding cost savings and identify corresponding conversion rates, (v) evaluate the decision maker's risk attitude via questionnaire, (vi) check the attributes' (utility) dependence via questionnaire, (vii) construct the decision tree, (viii) calculate utilities from MAU function, and (ix) choose the alternative with the highest expected value.

4. Results and Discussion

4.1. Payment Gateway

4.1.1. Uncertainties

Total cost depends on several uncertainties including number of sales per course launches. The decision maker's online education platform launches courses every six months. The second uncertainty is discounts from gateway platforms, which can vary depending on the company's monthly turnover. Overall total cost of implementing payment gateway is:

$$Total\ Cost = P * N * C_{variable} + C_{fixed} * N + C_{monthly\ fee} * t \quad (1)$$

Total Cost - total cost of using payment gateway for six months period;

P - average price of a product, KZT;

N - number of sales;

$C_{variable}$ - cost share as a percent charges from every transaction, %;

C_{fixed} - cost charged for every transaction, KZT;

$C_{monthly\ fee}$ - monthly subscription cost, KZT;

t - time, in months; taken as 6 months.

Time period to calculate the total cost is taken for a half-year, which aligns with the duration of a course launch in an IT academy.

For total cost calculations, the number of sales and average price were derived from historical data of the decision maker's business. Although the courses have a fixed one-time payment of 600,000 KZT, the average price paid by each customer is reduced due to the availability of 100% grants and discounts of 30% or 70%, which are frequently offered by the academy. By analyzing two past successful launches of 6-months lasting courses, two values of average price that overall customers paid for the product were determined: 279,500 and 326,000 KZT (so, range is 46,500), min. and max. values respectively.

The base value is the midpoint of the min. and max. values. Low value is the 10th percentile, 10% of the way from the min to the max, assuming a linear distribution, see Equation 2. Similarly, a high value is the 90th percentile (see Equation 3).

$$Low = 279,500 + (46,500 \times 0.1) = 279,500 + 4,650 \approx 284,000\ KZT \quad (2)$$

$$High = 279,500 + (46,500 \times 0.9) = 279,500 + 41,850 \approx 321,000\ KZT \quad (3)$$

Low, Base, High values (0.10, 0.50. 0.90 fractiles, respectively) of the number of sales were assessed from the decision maker. As an example, the decision maker was asked questions such as "What do you believe would be the number of sales per launch at which there is a probability of 90% that the outcome will be below it?". This is the High value. Number of sales and average price values are the same for all payment alternatives.

The values such as transaction fee, fixed fee, and monthly fee were derived for each alternative from payment gateways' official websites and/or by contacting them via email. Fixed and monthly costs are initially displayed in US dollars, as they typically pertain to international payment gateways. However, since total cost is calculated in KZT, fixed and monthly costs were converted according to conversion rate on 21th February, 2025 (505.91 KZT for 1 USD). The currency conversion rate was not considered as an uncertainty, as it was assumed that its impact would be minimal.

The percentage of transaction fee often varies based on the monthly turnover of the business. For instance, for Robokassa, the basic tariff plan starts at 3.9%, but a reduced rate

of 3.5% is set once the monthly turnover reaches or exceeds 5,000,000 KZT. In other words, with an increasing number of sales and average price of the products, the overall business turnover increases, which leads to a lower transaction percentage. To ensure accuracy when filling out the table, the average turnover was calculated beforehand to determine the appropriate transaction fees (see Table 3). For example, with the maximum values for the number of sales of 151 and average price of 326,000 KZT, the monthly business turnover exceeds 7.5 million KZT, qualifying for the reduced transaction fee of 3.5%. Consequently, for total cost calculations, high values of the number of sales and price correspond to low values of transaction fee.

Table 3

Fractiles of uncertainty of the attributes for Robokassa

Variable	**Measure**	**Values**				
		Min. Value	**Low**	**Base**	**High**	**Max. Value**
Number of Sales	integer	69	77	110	143	151
Average Price	KZT	279,500	284,000	303,000	321,000	326,000
Transaction Fee	%	3.5	3.5	3.5	3.9	3.9
Fixed Cost	KZT	0	0	0	0	0
Monthly Cost	KZT	0	0	0	0	0

Tables displaying cost components for payment gateways, similar to Table 3, were constructed for all remaining 11 alternatives under consideration; these tables are provided in the Appendix A. Total cost was computed through Equation 1 based on the tables for each of the alternatives (see Appendix C). Since the utility function must be an increasing function, cost savings were determined by comparing each alternative to the one with the highest max. value of total cost—in this case, PayPal, at 1,723,292.030 KZT. The cost savings were derived by calculating the difference between this maximum value and the total cost of each alternative (see Table 4). The highest maximum cost and lowest minimum cost, which are 1,369,709.68 and 0 KZT respectively, were included in the lottery game questionnaire to assess the risk attitude of the decision maker, see Figure 2.

Table 4

Cost savings per alternative

Cost Savings (KZT)	**Values**				
	Min. Value	**Low**	**Base**	**High**	**Max. Value**

Robokassa	32,509.68	148,814.68	588,869.68	902,567.68	1,003,285.18
Freedom Pay	32,509.68	148,814.68	588,869.68	990,039.68	1,080,427.18
Woopkassa kz	32,509.68	148,814.68	588,869.68	990,039.68	1,080,427.18
TipTop Pay	524,769.68	607,844.68	922,169.68	1,208,719.68	1,273,282.18
OneVision	770,899.68	837,359.68	1,088,819.68	1,318,059.68	1,369,709.68
Kaspi POS	611,521.68	687,950.68	977,129.68	1,240,755.68	1,300,153.18
Paypal	0.00	117,955.87	564,934.13	973,138.50	1,065,250.91
Stripe	58,817.96	173,014.14	605,504.65	1,000,221.16	1,089,240.34
Shopify	216,919.62	314,500.80	684,126.31	1,021,532.82	1,097,639.50
Square	304,947.96	402,529.14	772,154.65	1,109,561.16	1,185,667.84
HubSpot	267,156.48	363,523.48	728,140.48	1,060,538.48	1,135,430.98
Helcim	510,594.18	594,348.70	911,590.16	1,201,167.71	1,266,483.78

4.1.2 Risk attitude analysis

According to Farquhar (1984), there are four main categories of utility assessment methods: preference comparison methods, probability equivalence methods, value equivalence methods, certainty equivalence methods, and other additional methods such as hybrid assessment methods, paired-gamble methods etc. [44]. For assessing one-attribute (X_1 - cost savings in KZT) utility function, it was decided to use the certainty equivalence method, to come to the indifference point for the decision maker. Full test in the form of the lottery game questionnaire for attribute X_1 can be seen in Appendix D.

Figure 2 illustrates the completed lottery game questionnaire, which was received from the decision maker. Each comparison in Figure 2, indicated as (1) (2) (3) (4), followed one after another, since the values received from the decision maker were used in the following end nodes. For example, $X_{0.5}$ value obtained from the decision maker during comparison (1), was then used in comparison (2) as one of the end nodes. The X_{check} data point assisted for consistency check, meaning that the equal values of X_{check} and $X_{0.5}$ reveals ideal consistency of the decision maker. As seen from Figure 2 there is a small difference between X_{check} and $X_{0.5}$ values, which are 700,000 and 750,000 respectively. This means that the decision maker was slightly inconsistent during the test, showing some distortions in risk behavior which is common in certainty equivalence methods [45].

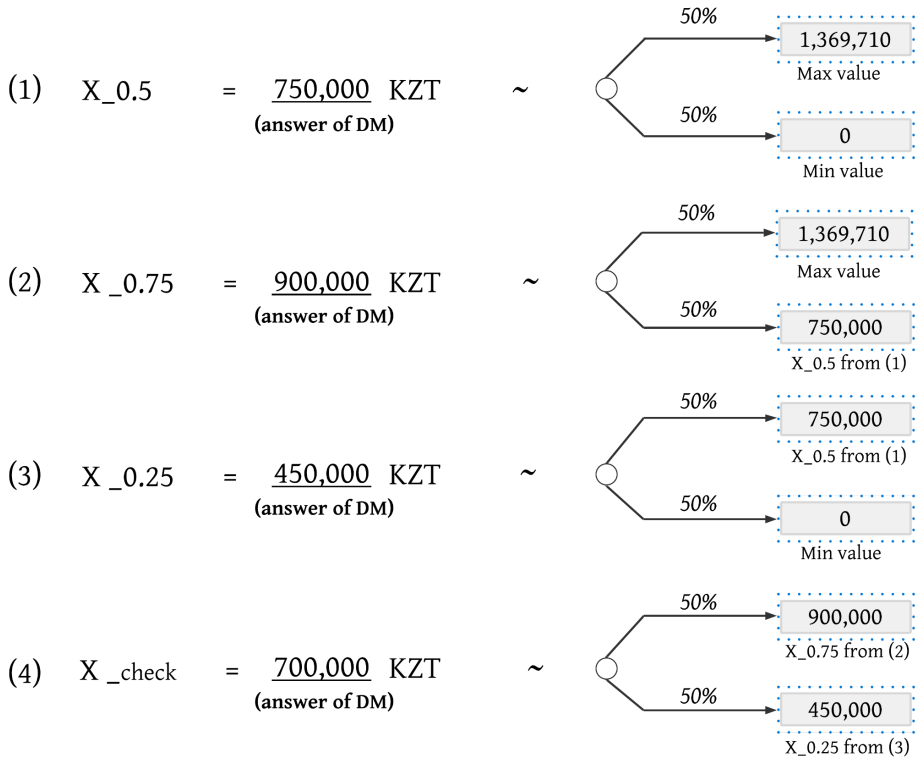


Figure 2. Test conducted with decision maker (DM) for Payment Gateways cost savings

Table 5

Data points assessed from the decision maker for one-attribute utility function of X_1

Data point	**Assessed value**
	X_1, KZT (cost savings)
X_1	1,369,710
$X_{0.75}$	900,000
$X_{0.5}$	750,000
$X_{0.25}$	450,000
X_0	0
X_{check}	700,000

Figure 3 illustrates the single-attribute utility function received from the decision maker, the utility curve was constructed using data points assessed from the decision maker. The data points are shown in Table 5. Then the utility curve was fitted using 3rd order polynomial curve fit to get the precise cubic polynomial utility function which is shown as Equation 4. The 2nd order polynomial curve fit was tested and identified as less precise than 3rd order polynomial fit, giving the R^2 coefficients of 0.9754 and 0.9929, respectively. Based on the obtained coefficients of determination (R^2), it was decided to further go with 3rd order polynomial curve fit. As it can be seen from Figure 3, the

decision maker showed patterns of both risk aversion and risk seeking throughout decision making, however, as the utility curve is mostly close to the line of best fit, lying on both sides and crossing best fit line (Risk neutral curve), the decision maker was considered as risk neutral over money.

The utility function was curve fitted to obtain the line of best fit using the least-square error approach. Line for risk-neutral behavior, as Figure 3 illustrates, was created by connecting the end nodes in the curve based on the data points received from the decision maker (maximum and minimum X values) and its equation in the form of y=ax+b was found (Equation 5).

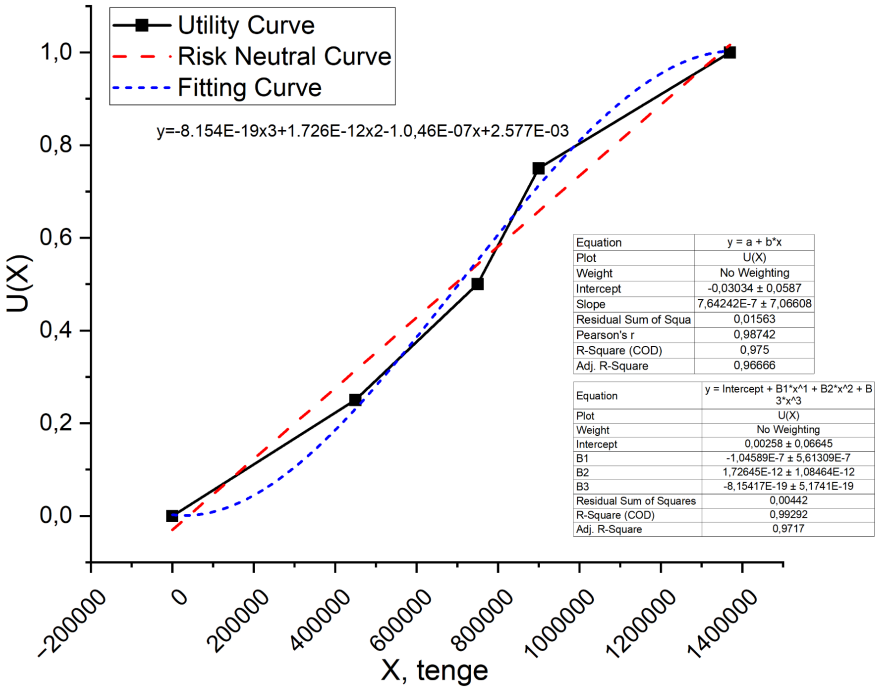


Figure 3. Real utility data points for attribute X_1

Utility function from DM:

$$U(X) = -8.154^{*}\ 10^{-19}x^{3} + 1.726^{*}\ 10^{-12}x^{2} - 1.046^{*}\ 10^{-7}x + 2.577^{*}\ 10^{-3} \quad (4)$$

Utility function for Linear Risk-Neutral Behavior:

$$U(X) = 7.301E^{-07}x \quad (5)$$

where, for both Equation (4) and (5), x is a value of cost savings in KZT, taken from Table 4.

4.1.3 Decision Tree

Utility value was calculated for each chance node of each 12 alternatives based on Equation (4), in total 36 utility values were derived, see Figure 4.

Expected value of each alternative was calculated by expected utility function:

$$E_{value} = 0.25U(X_{high}) + 0.5U(X_{base}) + 0.25U(X_{low}) \quad (6)$$

where X_{high} is a high value of cost savings in KZT, X_{base} is a base value of cost savings in KZT, X_{low} is a low value of cost savings in KZT. These values for each alternative were taken from Table 4.

Based on Equation 6, for 12 payment gateway alternatives, 12 expected utility values were derived, see Figure 4. The results of the evaluation of alternatives of payment gateway systems are shown in the rank-order in Table 6. OneVision was ranked as number 1 payment gateway system which maximizes cost savings, giving the expected utility value of 0.852, while Robokassa.kz was ranked last, giving the smallest expected utility value of 0.371.

Ranking of the payment gateway systems was evaluated in the case of risk-neutral behavior of the decision maker, using Equation 5 for derivation of utility values and Equation 6 for derivation of expected utility values based on utility values under ideal risk neutral behavior. As seen from Table 6, ranking of the payment systems stayed similar except the last 2 payment gateway systems which flipped their places. Under ideal risk neutral behavior Robokassa was ranked as number 11, while PayPal was ranked last, giving the value of 0,405. Full utility values and expected values for each alternative under Linear Risk-Neutral Behavior function are shown in Appendix E.

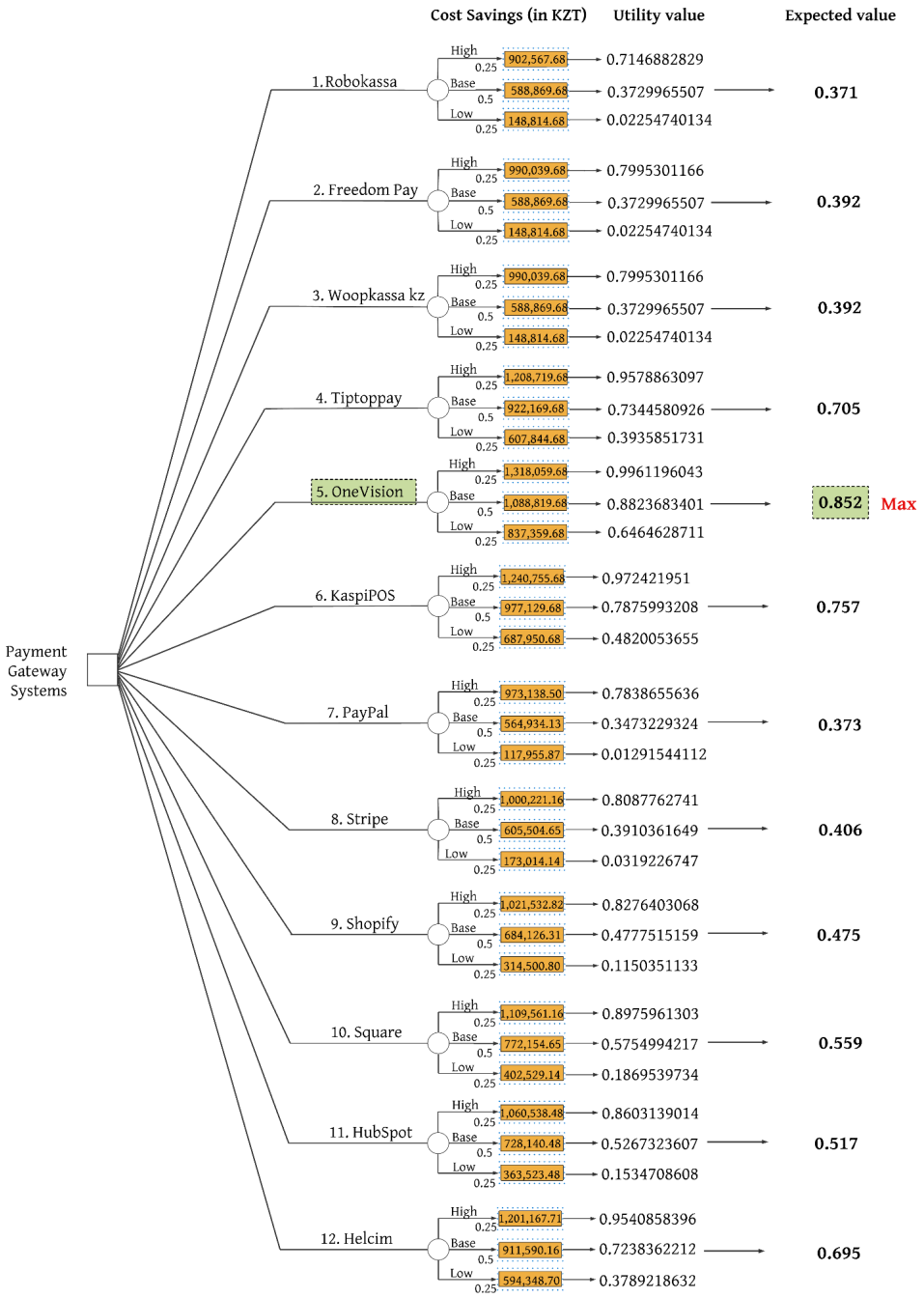


Figure 4. Decision tree for payment gateway systems

Table 6

Rank-order of the alternatives based on expected utility

Rank-order	Alternative	Expected utility (utility function of DM)	Expected utility (Linear Risk-Neutral Behavior)
#1	**OneVision**	0.852	0.791
#2	Kaspi POS	0.757	0.709
#3	TipTop Pay	0.705	0.668
#4	Helcim	0.695	0.660

Rank-order	Alternative	Expected utility (utility function of DM)	Expected utility (Linear Risk-Neutral Behavior)
#5	Square	0.559	0.558
#6	HubSpot	0.517	0.526
#7	Shopify	0.475	0.494
#8	Stripe	0.406	0.435
#9	Freedom Pay	0.392	0.423
#10	Woopkassa kz	0.392	0.423
#11	PayPal	0.373	**0.405**
#12	Robokassa kz	0.371	**0.407**

4.1.4 Discussion of results

Based on market share data, KaspiPos is the most popular payment gateway in Kazakhstan, which explains its second-place ranking on our list. Meanwhile, the most promising alternative for our decision maker is OneVision as it offers a low transaction fee of 2% and no additional costs. Although foreign gateway systems hold a larger overall market share, they fall behind the top three local Kazakhstani systems, as the latter are better adapted to the local market.

4.2. CRM Systems

4.2.1 Uncertainties

Total cost of CRM system usage depends on several uncertainties such as: the number of people who use the CRM, as the price is considered per-person basis and affects the final price; adoption time of particular CRM system, as the time needed for training staff and fully adopting CRM is difficult to predict and thus may affect the costs related to training, setup, and integration; conversion rate of the CRM, as the number of leads who become customers is uncertain. Total cost of implementing a CRM system for the first year is given in Equation 7.

$$Total\ Cost = C_{setup} + N * C_{subscription} + A * C_{integration} + C_{training} + C_{maintenance} \quad (7)$$

Total Cost - total cost of using CRM for the first year;

C_{setup}- Initial setup and customization cost;

$C_{subscription}$- Annual licensing fee, KZT;

N - Number of users;

A - Adoption Rate due to employee resistance;

$C_{integration}$ - Cost of integrating with existing systems;

$C_{training}$ - Cost for onboarding and training employees;

$C_{maintenance}$ - Ongoing maintenance and support fees;

To calculate the total cost, the setup, maintenance and training costs were collected from the websites of the CRMs or by directly contacting their official representatives/agents. Some CRM systems offered subscriptions per person and per month. Also, the price of CRM integration is offered per hour or in fixed hours (such as 10 service hours, 50 service hours, etc.). Therefore, the survey was conducted among the workers of the company of the DM to figure out the number of users of CRM and approximate time needed for these users to fully integrate it to their work routine. Different options of adoption time, number of users and other prices were considered and classified as minimum, maximum and base prices. Then, same as for the payment gateway, in order to evaluate cost savings, total cost was subtracted from the maximum of maximum total costs and then used as the first attribute.

Table 7 demonstrates the total cost savings for each alternative in fractiles of min, max, low, high, and base values, where low and high values were calculated as 10 percentile of minimum and maximum values. The total cost for each CRM alternative (see Appendix F) was calculated using equation 7 based on tabular data of each of alternatives (see Appendix B). Cost savings were found by calculating the difference of total cost of each alternative to the one with the highest maximum value of total cost: in this case, NetSuite CRM, at 69,945,976.44 KZT. The maximum and minimum values of cost savings were 68,938,648 and 0 KZT respectively, and were included in the lottery game questionnaire to assess the risk attitude of the decision maker.

Table 7

Cost savings per alternative

Cost Savings (KZT)	**Values**				
	Min. Value	**Low**	**Base**	**High**	**Max. Value**
Bitrix24	59,835,264.10	61,745,624.13	64,871,644.08	67,637,400.79	68,290,807.31
Freshsales	68,019,737.32	68,093,250.10	68,387,301.20	68,828,377.85	68,938,647.81
Hubspot	59,800,090.14	60,496,674.74	63,244,725.22	66,600,532.35	67,434,698.15
MD 365	48,422,201.40	50,069,793.71	56,673,180.85	63,188,199.50	64,816,954.17
Monday CRM	67,263,678.84	67,380,686.68	67,848,718.02	68,228,534.02	68,323,488.02
Netsuite CRM	0.00	4,921,271.90	24,606,359.49	45,639,181.30	50,437,931.90

Oracle Siebel	55,491,227.03	55,746,479.72	56,767,490.50	57,788,501.26	58,043,753.95
SuiteCRM	64,632,023.59	65,538,681.15	66,592,364.27	68,111,628.29	68,491,444.29
AmoCRM	58,973,952.68	59,015,547.02	59,181,924.38	60,920,342.86	60,958,351.98

To add more, estimated values of the conversion rate of each CRM were taken from case studies provided in the official website of the alternatives or provided in open sources. Case studies contained information about existing companies that adopted given types of CRM into their system and how it affected the statistics of the company, particularly, the number of people who were retained as customers.

Conversion rate of CRM depends on several uncertainties as well. The biggest uncertainty is feasibility of these values with the DM's company because the information about the type and number of workers, their age range, their experience level, and the type of customers involved in the case studies is not specified. Also, it is uncertain whether the values can be applied to DM's firm because it is an IT firm, while the companies described in the case studies are from different sectors, therefore trends in IT may affect the results differently.

Table 8 demonstrates the conversion rate savings for each alternative in fractiles of min, max, low, high, and base values. The maximum and minimum values of conversion rate increase were 200 and 4 percent (%), both for Bitrix24 CRM. These numbers were included in the part of the lottery game questionnaire for assessing the risk attitude of the decision maker in terms of conversion rate savings.

Table 8

Conversion Rate Values for CRM Alternatives

Conversion rate savings (%)	**Values**				
	Min. Value	**Low**	**Base**	**High**	**Max. Value**
Bitrix24	4%	5.26%	24.10%	152.00%	200.00%
Freshsales	10%	12.00%	20.00%	32.00%	35.00%
Hubspot	20%	22.00%	50.00%	56.51%	57.14%
MD 365	18%	10.20%	19.00%	27.80%	30.00%
Monday CRM	15%	18.00%	30.00%	42.00%	45.00%
Netsuite CRM	58%	60.00%	68.00%	76.00%	78.00%
Oracle Siebel	25%	30.00%	50.00%	70.00%	75.00%
SuiteCRM	25%	31.60%	58.00%	65.20%	67.00%
AmoCRM	20%	21.20%	25.00%	32.40%	34.00%

4.2.2 Risk attitude analysis

An analysis was done to identify the risk attitude of the decision maker on two attributes: expenditures on CRM systems and their conversion rate. For this, the same certainty equivalence method of utility assessment was used in the form of a lottery game. As there were two attributes in this case, the game consisted of five steps. First, a game for CRM cost savings was played. Maximum and minimum values of calculations are provided to the player in this assessment. In this case, the DM was given the maximum (68,938,648 KZT) and minimum (0 KZT) amounts of cost savings of all alternatives. Then, questions specifically designed for the selected topic are asked. For example, the DM was asked: "You have a CRM, which saves you 1 million KZT in cost. However, there is a new CRM that can save you 68,938,648 KZT with a 50% chance, if you adopt it. Would you adopt it or keep the current one?". The point of the game is to find the point of indifference for the player (when the player cannot decide to keep the current CRM or switch to the new one) to further identify the risk behavior of the participant. This point is marked as $X_{0.5}$. Then, following the same procedure, points $X_{0.25}$ (between $X_{0.5}$ and X_{min}), $X_{0.75}$ (between $X_{0.5}$ and X_{max}), and X_{check} (between $X_{0.25}$ and $X_{0.75}$) were found. Detailed schematic of the game is presented in Figure 5. Also, table 9 demonstrates the values for each probability point. It is seen that there is a difference in $X_{0.5}$ and X_{check} values, but the values are close enough. This kind of mismatch is common in the certainty equivalence method and shows a slight inconsistency of the DM answers during the test.

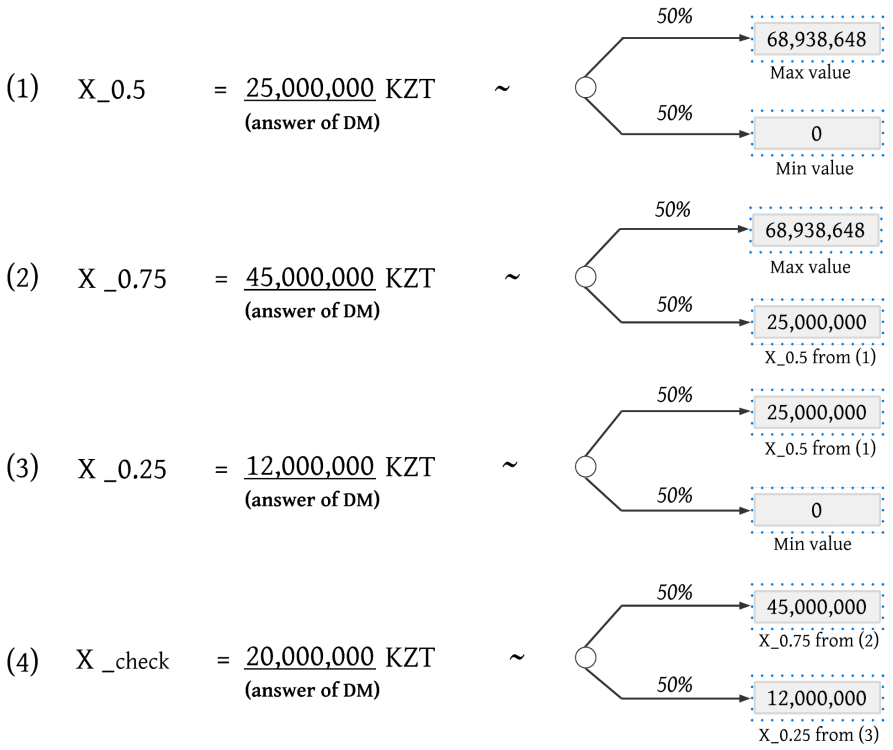


Figure 5. Test conducted with decision maker (DM) for CRM system cost savings

Table 9

Data points assessed from the decision maker for the utility function of X_1

Data point	Assessed value
	X_1, KZT (cost savings)
X_1	68,938,648
$X_{0.75}$	45,000,000
$X_{0.5}$	25,000,000
$X_{0.25}$	12,000,000
X_0	0
X_{check}	20,000,000

Second, the same procedure was repeated, but for conversion rate savings from CRM. It is the value of how many leads become customers after implementing a CRM system. Schematic of the game with chance nodes and points of indifference is demonstrated in Figure 6. Points and corresponding probabilities of this part are given in Table 10. Unlike the minimum value of the cost savings part, the minimum value equals 4% because adoption of CRM must lead to an increase in the number of customers and thus cannot be equal to zero. Values of $X_{0.5}$ and X_{check} are equal, meaning there was no inconsistency.

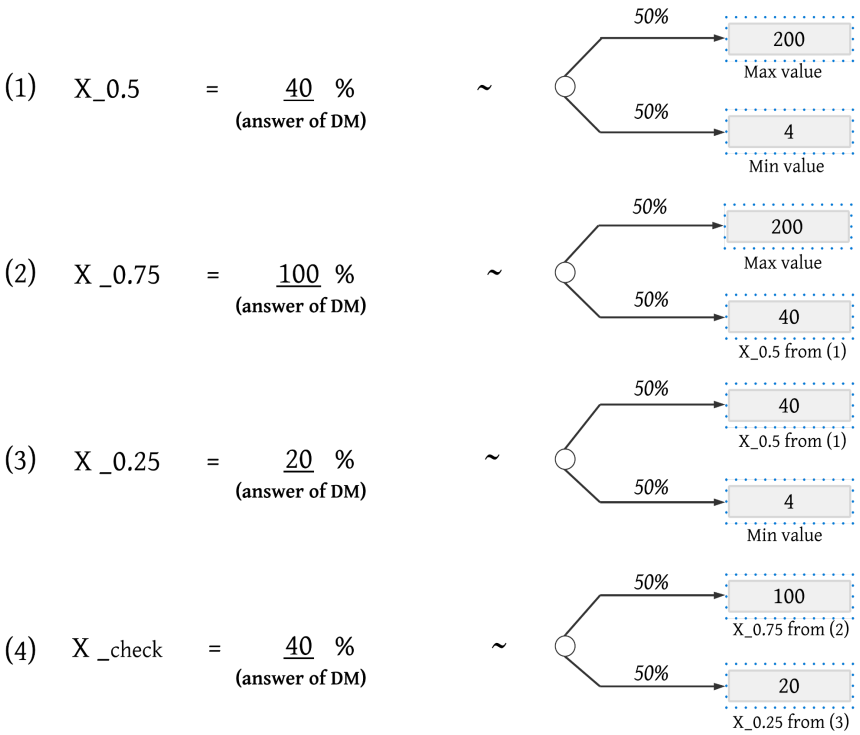


Figure 6. Test conducted with decision maker (DM) for CRM conversion rate increase

Table 10

Data points assessed from the decision maker for the utility function of X_2

Data point	Assessed value
	X_2, % (conversion rate savings)
X_1	200
$X_{0.75}$	100
$X_{0.5}$	40
$X_{0.25}$	20
X_0	4
X_{check}	40

Based on the results given in Tables 8 and 9, data points were created, and separate single-attribute utility curves were built for cost savings and conversion rate increase in Excel. For the values of the Y axis, probabilities 0, 0.25, 0.5, 0.75, and 1 were taken, and the values of cost savings and conversion rate increase were put on the X axis on their corresponding graphs. The risk curves are given in Figures 7 and 8.

From Figure 7, it is seen that the DM performed risk-averse behavior in terms of cost savings as the risk curve (black color) is located above the risk-neutrality line (red color). Then, 4-parameter logistic (4PL) regression was used to fit the utility curve. This curve fitting method was chosen because it has the highest R-square value, 0.9995, compared to polynomial, exponential, and power regression models. Equation of 4-parameter logistic (4PL) regression gives the utility function from DM:

$$U(X_1) = 2.247439 + \frac{-2.248411706}{1+(\frac{x}{85680740})^{1.040351}}, R^2 = 0.9995 \quad (8)$$

where, X_1 is the value of cost savings from CRM and Y is the value of corresponding probability.

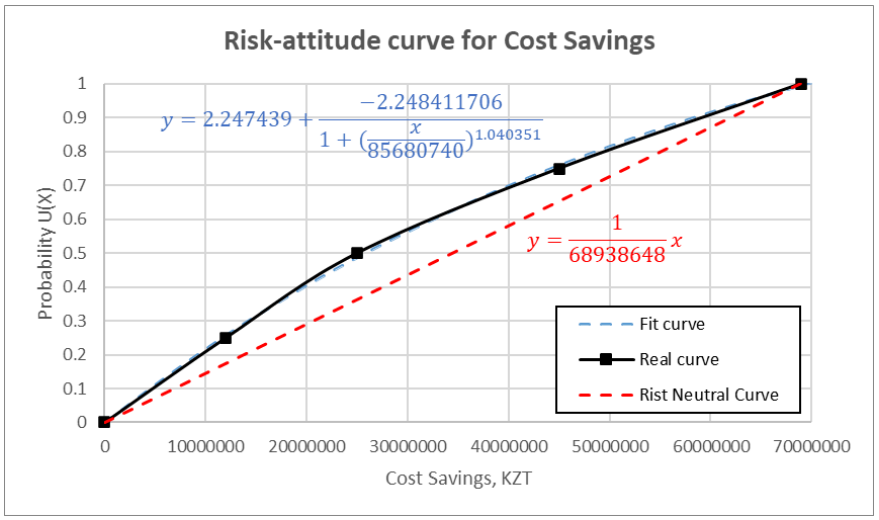


Figure 7. Utility data points for attribute X_1

Figure 8 demonstrates the risk curve created from data points of DM's answers for conversion rate assessment. For plotting and further calculations, the magnitudes of conversion rate savings were taken as fractions, but not percentages (not units). It is clear that the curve has risk-averse behavior as well. Similarly, 4-parameter logistic (4PL) regression was used to fit the utility curve by the reason that it gives better approximation to the original data and has higher R-squared value. Equation of 4-parameter logistic (4PL) regression gives the utility function from DM:

$$U(X_2) = 1.56677 + \frac{-1.7138543}{1+(\frac{x}{0.835844})^{0.7877729}}, \; R^2 = 0.9968 \qquad (9)$$

where, X_2 is the value of conversion rate savings from CRM and Y is the value of probability.

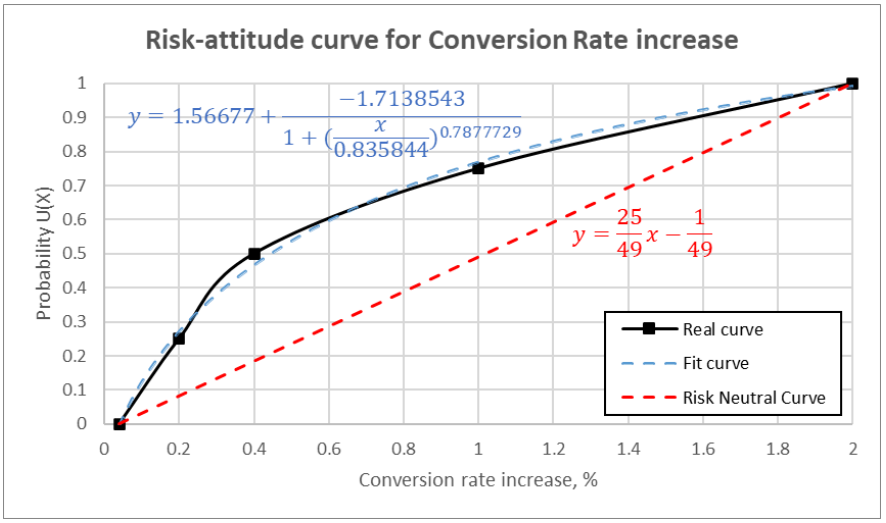
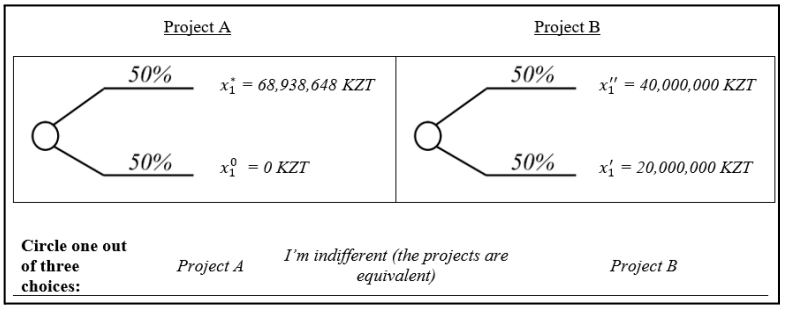


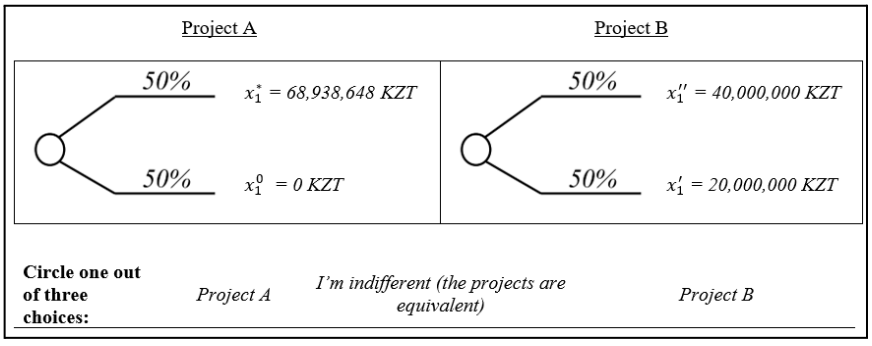
Figure 8. Real utility data points for attribute X_1

Third and fourth steps had the purpose of determining the potential utility interdependence between cost savings (X_1) and conversion rate savings (X_2). To explain, in the third step, the dependence of X_1 from X_2 was assessed. DM was given the following three questions that are given in Figure 9.

a) *Scenario 1. In this scenario both projects have the fixed Conversion Rate Savings in Percentage which is equal to* x_2^0 *= 4 %. Given two projects A and B with a 50/50 chance of getting different cost savings, which project would you prefer?*



b) *Scenario 2. If in both projects the value will be* x_2^* *= 200 %. Which project would you prefer in this scenario?*



c) *If the value of attribute X_2 in scenario 1 or 2 were held fixed at some other value between 4% and 200 %, would your answer change?*

Circle your answer: *Yes* *No*

Figure 9. Questions for assessing the dependence of X_1 from X_2

In the fourth step, the same questions were asked, but to check the dependence of X_2 from X_1, so all the values were interchanged. For both steps, all the answers for questions a, b, and c were "Project B", "Project B", and "No"; so it can be interpreted that two

attributes X_1 and X_2 are utility independent of each other [45]. Therefore, the MAU function for selecting the CRM system takes the multilinear form [46]:

$$U(X_1, X_2) = k_1 * U(X_1) + k_2 * U(X_2) + k_{12} * U(X_1)U(X_2) \quad (10)$$

where $U(X_i) = U(X_i|\overline{X}_i)$ and the scaling constants will be equal to $k_1 = U(x_1^*, x_2^0),\ k_2 = U(x_1^0, x_2^*),\ and\ k_{12} = 1 - k_1 - k_2$.

The final stage was conducting a questionnaire with the DM to get the values of probability for the calculation of these coefficients (k_1, k_2) for MAU function. The content was similar to the ones in the third and fourth steps, but the variable is chosen to be probability p for this problem. The questions are provided in Figure 10.

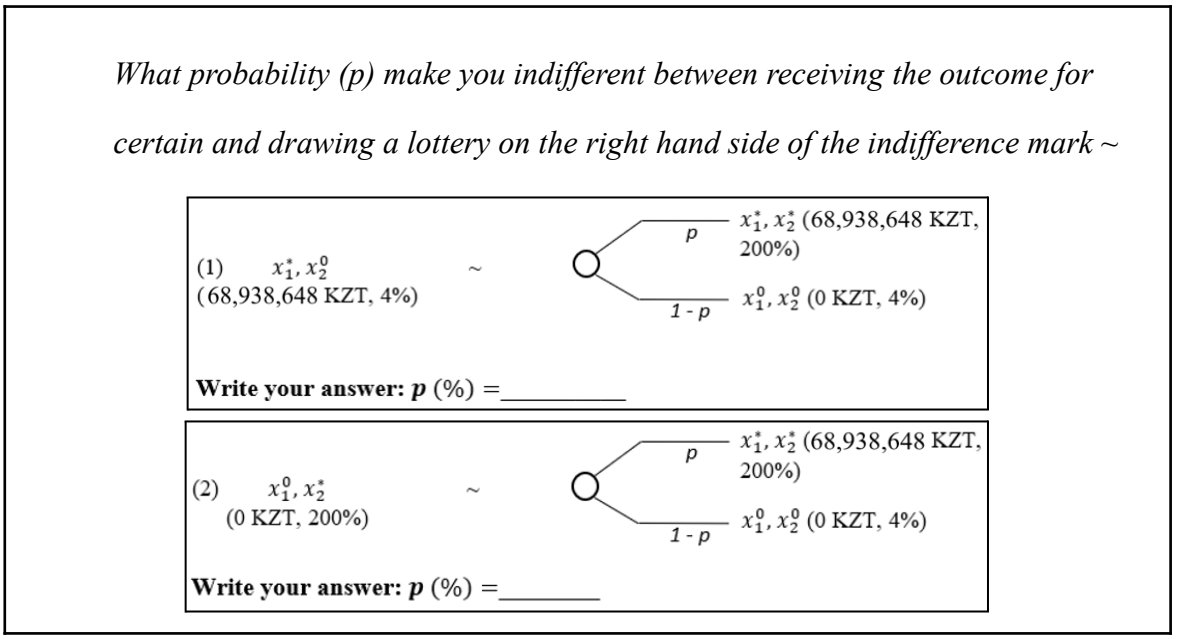


Figure 10. Coefficient assessment questionnaire for MAU function

Answers of the DM were 40% and 30% for the first and second questions, respectively. These probabilities give the value of coefficients k_1 and k_2. So, the general form of the MAU function for the CRM selection model is determined as:

$$U(X_1, X_2) = 0.4U(X_1) + 0.3U(X_2) + 0.3U(X_1)U(X_2) \quad (11)$$

4.2.3 Decision Tree

Utility values for cost savings (X_1), Utility values for conversion rate (X_2) were calculated for each chance node of each 9 alternatives based on Equation (8) and Equation (9), respectively. In total 81 $U(X_1)$ utility values and 81 $U(X_2)$ utility values were derived, see Figure 9. Further, these utility values were used to derive $U(X_1,X_2)$ multi-attribute

utility function (MAU), based on Equation 11. In total 81, and for each CRM system alternative 9 $U(X_1,X_2)$ MAU values were derived. Further these MAU function values were incorporated into the Equation 12, to derive von Neumann-Morgenstern utility function $U(P_1,P_2,U(X_1,X_2))$, which is used for modeling how decision makers (DM) make decisions under uncertainty, when existing probabilities are considered. These derivations are made to simplify calculation of the final expected utility values for alternatives. Von Neumann-Morgenstern utility function was derived by:

$$U(P_1, P_2, U(X_1, X_2)) = P_1 * P_2 * U(X_1, X_2) \quad (12)$$

where P_1 is a probability of X_1 (cost savings) attribute, P_2 is a probability of X_2 (conversion rate) attribute, $U(X_1,X_2)$ is total MAU function which is derived as mentioned above, from Equation 11. Further, expected value of each alternative was calculated by expected utility function:

$$E_{value} = \sum P_1 * P_2 * U(X_1, X_2) \quad (13)$$

As shown in Equation 13, expected value calculation was simplified as the simple weighted sum of von Neumann-Morgenstern utility functions derived earlier.

Based on Equation 13, for 9 CRM system alternatives, 9 expected utility values were derived, see Figure 11. The results of the evaluation of alternatives of CRM systems are shown in the rank-order in Table 11. SuiteCRM was ranked as number 1 CRM system which is considered as the most beneficial available CRM system based on key attributes like cost savings (X_1) and conversion rate (X_2), giving the maximum expected utility value of 0.7222, while NetSuite was ranked last, giving the smallest expected utility value of 0.4672.

Decision tree for the CRM system is shown in Figure 11, considering the huge size of the whole decision tree, it was decided to show full calculated utility values, such as $U(X_1)$, $U(X_2)$, $U(X_1,X_2)$, and $U(P_1,P_2,U(X_1,X_2))$ for only 3 CRM alternatives, as shown in Figure 11, for all other alternatives, expected values are shown. The whole utility values and accompanying values of each CRM alternative are shown in Appendix G.

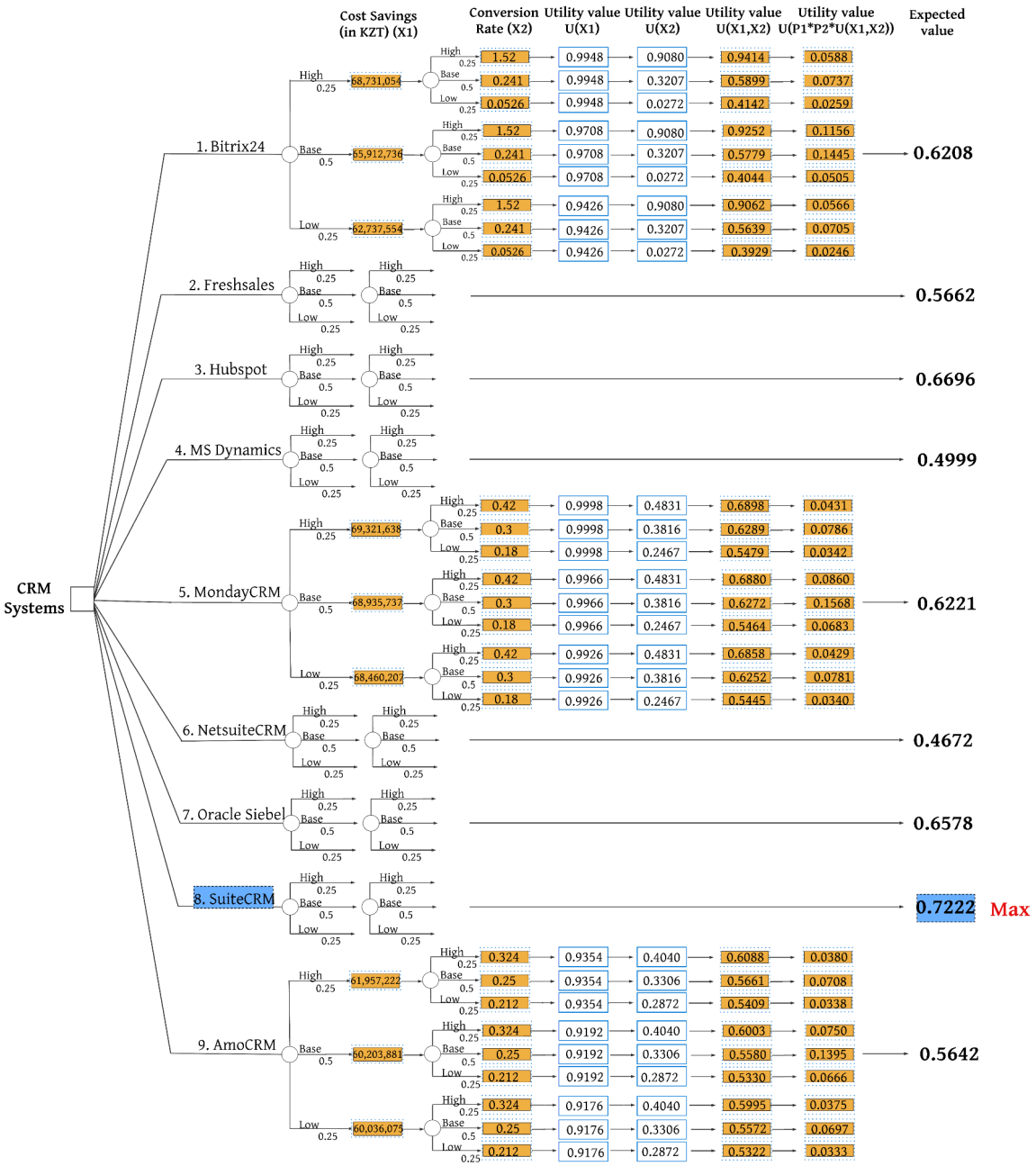


Figure 11. Decision tree for CRM systems

Table 11

Rank-order of the alternatives based on expected utility

Rank-order	Alternative	Expected utility (utility function of DM)
#1	**SuiteCRM**	0.722
#2	HubSpot	0.670
#3	Oracle Siebel	0.658
#4	MondayCRM	0.622
#5	Bitrix24	0.621

Rank-order	Alternative	Expected utility (utility function of DM)
#6	Freshsales	0.566
#7	AmoCRM	0.564
#8	MS Dynamics 365	0.450
#9	NetSuite	0.467

4.2.4. Discussion of results

According to the decision tree for CRM systems on Figure 11 and ranking on Table 11, SuiteCRM is the number one option for the decision maker with the highest expected utility value of 0.7222. This is very much expected results taking into account that SuiteCRM does not have subscription, setup, integration costs due to its unique open-source nature. It only has maintenance and training costs, which makes it one of the best ones in cost saving. However, the conversion rate values are also quite good, base value being 65.20%.

5. Conclusion

This research work developed decision analysis models for selecting a CRM system and a payment gateway for SMEs based on the MAU theory. Selection of a CRM system was based on cost saving and lead conversion rate as key attributes, while payment focused only on cost saving. By quantitative analysis of the costs associated with the payment system, such as transaction fees, fixed costs and monthly costs, the decision tree was developed to rank different payment gateways based on their overall utility. The decision framework for CRM based on the MAU theory enabled an objective comparison of trade-offs between cost efficiency and lead conversion performance, taking into account the decision maker's tolerance for uncertainty. By analysis of both affordability and performance, the decision model provided a systematic approach to rank CRM alternatives based on their overall utility.

Based on a risk-neutral attitude of the decision maker, platforms such as OneVision, Kaspi POS, and TipTop Pay emerged as optimal choices when prioritizing cost-efficiency metrics. While for CRM, risk-averse attitude was observed for both attributes with the full independence between them. The quantitative analysis based on the decision-maker's uncertainty tolerance revealed that SuiteCRM, HubSpot, and Oracle Siebel were the best ones among evaluated alternatives.

Although the study proposes a novel application of the MAU theory for decision analysis in business/management problems, it has some limitations. MAU method requires numerical inputs, which inherently excludes important but non-quantifiable attributes or qualitative factors such as vendor support, data security, and ease of implementation. To input different values of uncertainties (e.g., high, low, base) linear distribution was assumed, which may not fully reflect the real-world cases. Additionally, utility values heavily depend on precision of the data, which may have some inaccuracies due to difficulties in estimating and lack of data. The study relied on estimated or self-reported data from CRM systems, which may introduce biases or inaccuracies in utility calculations. Furthermore, assumptions such as fixed currency conversion rates and the omission of marketing incentives in calculations underscore the importance of further research to better reflect real-world business scenarios.

Future researchers can expand this framework by incorporating additional attributes (e.g., scalability, implementation speed) or evaluating more CRM/payment alternatives—provided they collect the necessary data. Additionally, since the MAU theory integrates the risk attitude of the decision maker, the shift in risk preferences due to different market conditions (e.g., economic shocks) could be explored to make a dynamic risk modelling.

Ultimately, this paper lays the groundwork for future use of MAU theory in decision analysis for businesses, guiding SMEs toward optimized and data-driven solutions that enhance both financial and operational performance in an increasingly competitive marketplace.

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Appendix A

Collected data for FreedomPay.

Variable	Measure	Values

		Min. Value	Low	Base	High	Max. Value
Transaction Fee	%	3.5	3.5	3.5	3.9	3.9
Fixed Cost	KZT	0	0	0	0	0
Monthly Cost	KZT	0	0	0	0	0

Collected data for Woopkassa.

Variable	Measure	Values				
		Min. Value	Low	Base	High	Max. Value
Transaction Fee	%	3.5	3.5	3.5	3.5	3.5
Fixed Cost	KZT	0	0	0	0	0
Monthly Cost	KZT	0	0	0	0	0

Collected data for Tip Top Pay.

Variable	Measure	Values				
		Min. Value	Low	Base	High	Max. Value
Transaction Fee	%	2.5	2.5	2.5	2.5	2.5
Fixed Cost	KZT	0	0	0	0	0
Monthly Cost	KZT	0	0	0	0	0

Collected data for OneVision.

Variable	Measure	Values				
		Min. Value	Low	Base	High	Max. Value
Transaction Fee	%	2.0	2.0	2.0	2.0	2.0
Fixed Cost	KZT	0	0	0	0	0
Monthly Cost	KZT	0	0	0	0	0

Collected data for Kaspi POS.

Variable	Measure	Values				
		Min. Value	Low	Base	High	Max. Value
Transaction Fee	%	2.3	2.3	2.3	2.3	2.3
Fixed Cost	KZT	0	0	0	0	0
Monthly Cost	KZT	1,950	1,950	1,950	1,950	1,950

Collected data for PayPal.

Variable	Measure	Values

		Min. Value	Low	Base	High	Max. Value
Transaction Fee	%	3.49	3.49	3.49	3.49	3.49
Fixed Cost	KZT	247.90	247.90	247.90	247.90	247.90
Monthly Cost	KZT	1,950	1,950	1,950	1,950	1,950

Collected data for Stripe.

Variable	Measure	Values				
		Min. Value	Low	Base	High	Max. Value
Transaction Fee	%	3.40	3.40	3.40	3.40	3.40
Fixed Cost	KZT	151.773	151.773	151.773	151.773	151.773
Monthly Cost	KZT	0	0	0	0	0

Collected data for Shopify.

Variable	Measure	Values				
		Min. Value	Low	Base	High	Max. Value
Transaction Fee	%	2.9	2.9	2.9	2.9	2.9
Fixed Cost	KZT	151.733	151.733	151.733	151.733	151.733
Monthly Cost	KZT	14,671.39	14,671.39	14,671.39	14,671.39	14,671.39

Collected data for Square.

Variable	Measure	Values				
		Min. Value	Low	Base	High	Max. Value
Transaction Fee	%	2.90	2.90	2.90	2.90	2.90
Fixed Cost	KZT	151.773	151.773	151.773	151.773	151.773
Monthly Cost	KZT	0	0	0	0	0

Collected data for Hubspot.

Variable	Measure	Values				
		Min. Value	Low	Base	High	Max. Value
Transaction Fee	%	2.90	2.90	2.90	2.90	2.90
Fixed Cost	KZT	151.773	151.773	151.773	151.773	151.773
Monthly Cost	KZT	10,118.20	10,118.20	10,118.20	10,118.20	10,118.20

Collected data for Helcim.

Variable	Measure	Values				
		Min. Value	Low	Base	High	Max. Value
Transaction Fee	%	2.49	2.49	2.49	2.49	2.49

Fixed Cost	KZT	126.478	126.478	126.478	126.478	126.478
Monthly Cost	KZT	0	0	0	0	0

Appendix B

Bitrix's gathered data

Subscription Fee (KZT)	SetUp Cost	Integration Rate (KZT / hour)	Maintenance Cost	Training Cost	Conversion Rate
302,753.98	114,000.00	0.00	0.00	403,470.60	4%
536,513.01	240,000.00	33,467.70	924,223.46	1,287,219.30	8.2%
1,077,145.11	396,000.00			1,853,595.80	40%
2,158,409.33					200%

Hubspot's gathered data

Subscription Fee (KZT)	SetUp Cost	Integration Rate (KZT / hour)	Maintenance Cost	Training Cost	Conversion Rate
1,668,236.22	0.00	321.80	0.00	0.00	20%
2,780,393.69		965.41		3,604,214.05	25.%
		1,930.83		6,178,652.65	50%
		4,827.07			55.56%
					57.14%

Oracle Siebel CRM's gathered data

Subscription Fee (KZT)	SetUp Cost	Integration Rate (KZT / hour)	Maintenance Cost	Training Cost	Conversion Rate
5,792,486.86	2,574,438.61	0.00	424,782.37	2,363,534.00	75%
	5,148,877.21				25%

Monday CRM's gathered data

Subscription Fee (KZT)	SetUp Cost	Integration Rate (KZT / hour)	Maintenance Cost	Training Cost	Conversion Rate
222,431.50	257,443.86	0.00	0.00	307,387.97	15%
315,111.29	1,029,775.44				45%
519,006.82					15%

Freshsales's gathered data

Subscription Fee (KZT)	SetUp Cost	Integration Rate (KZT / hour)	Maintenance Cost	Training Cost	Conversion Rate
166,823.62	0.00	0.00	0.00	307,387.97	10%
722,902.36					20%

1,093,621.52					35%

Microsoft Dynamics's gathered data

Subscription Fee (KZT)	SetUp Cost	Integration Rate (KZT / hour)	Maintenance Cost	Training Cost	Conversion Rate
1,204,837.27	2,574,438.61	337.90	0.00	514,887.72	8%
1,946,275.59	15,446,631.6	482.71		2,574,438.61	30%
2,780,393.69					

Netsuite CRM's gathered data

Subscription Fee (KZT)	SetUp Cost	Integration Rate (KZT / hour)	Maintenance Cost	Training Cost	Conversion Rate
1,835,059.84	12,872,193.03	77,233.16	0.00	1,029,775.44	58%
	51,488,772.10	154,466.32		7,723,315.82	78%

SuiteCRM's gathered data

Subscription Fee (KZT)	SetUp Cost	Integration Rate (KZT / hour)	Maintenance Cost	Training Cost	Conversion Rate
0.00	0.00	0.00	0.00	617,865.27	25%
			1,730,022.74	1,668,236.22	58%
				2,780,393.69	67%

AmoCRM's gathered data

Subscription Fee (KZT)	SetUp Cost	Integration Rate (KZT / hour)	Maintenance Cost	Training Cost	Conversion Rate
179,964.00	35,660.00	200,000.00	0.00	0.00	20%
341,964.00	65,337.00				23%
521,964.00	95,094.00				25%
					30%
					34%

Appendix C

Total cost calculated per each payment gateway alternative

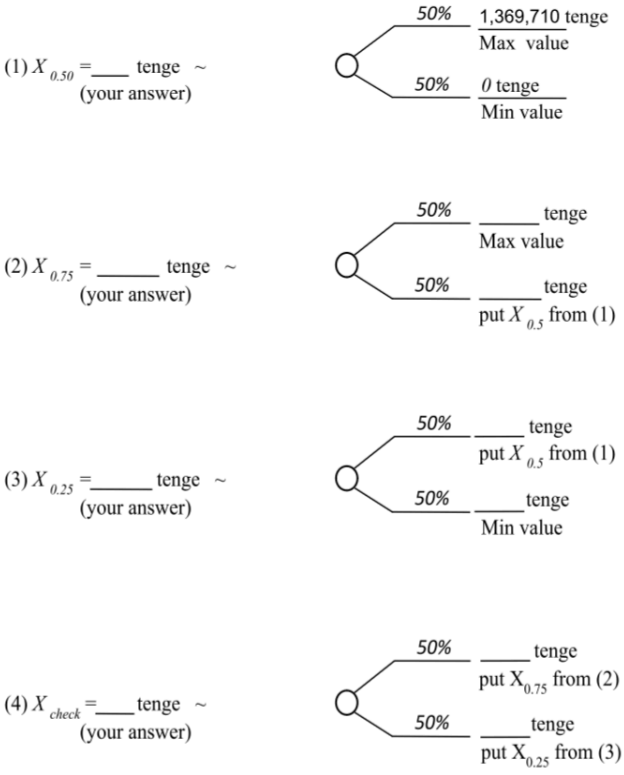
Total Cost (KZT)	Values				
	Min. Value	Low	Base	High	Max. Value
Robokassa	752,134.500	852,852.000	1,166,550.000	1,606,605.000	1,722,910.000
Freedom Pay	674,992.500	765,380.000	1,166,550.000	1,606,605.000	1,722,910.000

Woopkassa kz	674,992.500	765,380.000	1,166,550.000	1,606,605.000	1,722,910.000
TipTop Pay	482,137.500	546,700.000	833,250.000	1,147,575.000	1,230,650.000
OneVision	385,710.000	437,360.000	666,600.000	918,060.000	984,520.000
Kaspi POS	455,266.500	514,664.000	778,290.000	1,067,469.000	1,143,898.000
Paypal	675,487.920	765,898.210	1,167,081.300	1,607,038.290	1,723,292.030
Stripe	560,763.690	635,828.270	968,936.100	1,334,262.930	1,430,802.010
Shopify	577,541.190	652,605.770	985,713.600	1,351,040.430	1,447,579.510
Square	560,763.690	635,828.270	968,936.100	1,334,262.930	1,430,802.010
HubSpot	664,310.820	752,115.820	1,141,823.820	1,569,305.820	1,682,287.820
Helcim	481,445.430	545,893.040	831,888.200	1,145,547.260	1,228,433.320

Appendix D

Elicitation of the utility function of attribute X_1 (cost saving, KZT)

In tests below, please, write down in blank (____) spaces the amount of KZT saved on transactions when using payment gateways (e.g., Helcim, JetPay), X_1, which make you indifferent between receiving the number for certain and drawing a lottery on the right hand side of the indifference mark ~.



Appendix E

Utility value and expected value calculated for each payment gateway alternatives under assumption of ideal risk neutrality

		Cost savings, (KZT)	Linear Risk Neutral utility function: y = 1/369710X	Equation (3)
Alternative	Probability	Max value	Utility value	**Expected value**

	0.25	902,567.68	0.659	
	0.5	588,869.68	0.430	
Robokassa kz	0.25	148,814.68	0.109	**0.407**
	0.25	990,039.68	0.723	
	0.5	588,869.68	0.430	
Freedom Pay	0.25	148,814.68	0.109	**0.423**
	0.25	990,039.68	0.723	
	0.5	588,869.68	0.430	
Woopkassa kz	0.25	148,814.68	0.109	**0.423**
	0.25	1,208,719.68	0.882	
	0.5	922,169.68	0.673	
Tiptoppay	0.25	607,844.68	0.444	**0.668**
	0.25	1,318,059.68	0.962	
	0.5	1,088,819.68	0.795	
OneVision	0.25	837,359.68	0.611	**0.791**
	0.25	1,240,755.68	0.906	
	0.5	977,129.68	0.713	
KaspiPOS	0.25	687,950.68	0.502	**0.709**
	0.25	973,138.50	0.711	
	0.5	564,934.13	0.412	
PayPal	0.25	117,955.87	0.086	**0.405**
	0.25	1,000,221.16	0.730	
	0.5	605,504.65	0.442	
Stripe	0.25	173,014.14	0.126	**0.435**
	0.25	1,021,532.82	0.746	
	0.5	684,126.31	0.499	
Shopify	0.25	314,500.80	0.230	**0.494**
	0.25	1,109,561.16	0.810	
	0.5	772,154.65	0.564	
Square	0.25	402,529.14	0.294	**0.558**
	0.25	1,060,538.48	0.774	
	0.5	728,140.48	0.532	
HubSpot	0.25	363,523.48	0.265	**0.526**
	0.25	1,201,167.71	0.877	
	0.5	911,590.16	0.665	
Helcim	0.25	594,348.70	0.434	**0.660**

Appendix F

Total cost calculated per each CRM alternative

Total Cost (KZT)	Values				
	Min. Value	**Low**	**Base**	**High**	**Max. Value**
Bitrix24	821,753.46	1,483,229.06	4,283,115.54	7,446,775.86	9,380,299.31
Freshsales	167,418.93	279,031.55	725,482.04	1,023,115.70	1,097,524.11
Hubspot	1,689,691.08	2,534,019.89	5,930,712.34	8,712,243.55	9,417,314.95
MS Dynamics	4,339,328.21	5,987,926.72	12,582,320.78	19,266,159.94	20,933,825.61
Monday CRM	790,072.68	886,183.55	1,270,627.02	1,744,360.59	1,862,793.99
Netsuite CRM	18,893,536.56	23,750,752.50	45,039,826.62	64,964,746.47	69,945,976.44
Oracle Siebel	11,186,615.08	11,444,977.63	12,478,427.83	13,511,878.03	13,770,240.58
SuiteCRM	620,070.12	1,004,513.59	2,542,287.49	3,608,808.10	4,526,511.88
AmoCRM	8,215,624.00	8,253,959.40	10,007,301.00	10,175,106.60	10,217,058.00

Appendix G

Utility values and expected value calculated for each CRM alternatives

Alternative	X1	X2	P1	P2	P1*P2	k1	k2	k12	U(X1)	U(X2)	U(X1, X2)	P1*P2 *U(X1 ,X2)	EXP(U)
	68731054.16	1.52	0.25	0.25	0.0625	0.4	0.3	0.3	0.9949	0.9080	0.9414	0.0588	
	68731054.16	0.241	0.25	0.5	0.125	0.4	0.3	0.3	0.9949	0.3207	0.5899	0.0737	
	68731054.16	0.0526	0.25	0.25	0.0625	0.4	0.3	0.3	0.9949	0.0272	0.4142	0.0259	
	65912736.92	1.52	0.5	0.25	0.125	0.4	0.3	0.3	0.9708	0.9080	0.9252	0.1156	
	65912736.92	0.241	0.5	0.5	0.25	0.4	0.3	0.3	0.9708	0.3207	0.5779	0.1445	
	65912736.92	0.0526	0.5	0.25	0.125	0.4	0.3	0.3	0.9708	0.0272	0.4044	0.0505	
	62737554.52	1.52	0.25	0.25	0.0625	0.4	0.3	0.3	0.9426	0.9080	0.9062	0.0566	
	62737554.52	0.241	0.25	0.5	0.125	0.4	0.3	0.3	0.9426	0.3207	0.5639	0.0705	
Bitrix24	62737554.52	0.0526	0.25	0.25	0.0625	0.4	0.3	0.3	0.9426	0.0272	0.3929	0.0246	0.6208
	69931092.74	0.32	0.25	0.25	0.0625	0.4	0.3	0.3	1.0049	0.4004	0.6428	0.0402	
	69931092.74	0.2	0.25	0.5	0.125	0.4	0.3	0.3	1.0049	0.2724	0.5658	0.0707	
	69931092.74	0.12	0.25	0.25	0.0625	0.4	0.3	0.3	1.0049	0.1582	0.4971	0.0311	
	69482949.5	0.32	0.5	0.25	0.125	0.4	0.3	0.3	1.0012	0.4004	0.6408	0.0801	
	69482949.5	0.2	0.5	0.5	0.25	0.4	0.3	0.3	1.0012	0.2724	0.5640	0.1410	
	69482949.5	0.12	0.5	0.25	0.125	0.4	0.3	0.3	1.0012	0.1582	0.4955	0.0619	
	69184187.34	0.32	0.25	0.25	0.0625	0.4	0.3	0.3	0.9987	0.4004	0.6395	0.0400	
	69184187.34	0.2	0.25	0.5	0.125	0.4	0.3	0.3	0.9987	0.2724	0.5628	0.0704	
Freshsales	69184187.34	0.12	0.25	0.25	0.0625	0.4	0.3	0.3	0.9987	0.1582	0.4943	0.0309	0.5662
	67667554.43	0.5651	0.25	0.25	0.0625	0.4	0.3	0.3	0.9859	0.5788	0.7392	0.0462	
	67667554.43	0.5	0.25	0.5	0.125	0.4	0.3	0.3	0.9859	0.5387	0.7153	0.0894	
	67667554.43	0.22	0.25	0.25	0.0625	0.4	0.3	0.3	0.9859	0.2967	0.5711	0.0357	
	64257983.15	0.5651	0.5	0.25	0.125	0.4	0.3	0.3	0.9562	0.5788	0.7221	0.0903	
Hubspot													0.6696

	64257983.15	0.5	0.5	0.5	0.25	0.4	0.3	0.3	0.9562	0.5387	0.6987	0.1747	
	64257983.15	0.22	0.5	0.25	0.125	0.4	0.3	0.3	0.9562	0.2967	0.5566	0.0696	
	61465905.54	0.5651	0.25	0.25	0.0625	0.4	0.3	0.3	0.9309	0.5788	0.7076	0.0442	
	61465905.54	0.5	0.25	0.5	0.125	0.4	0.3	0.3	0.9309	0.5387	0.6844	0.0856	
	61465905.54	0.22	0.25	0.25	0.0625	0.4	0.3	0.3	0.9309	0.2967	0.5442	0.0340	
	64200551.83	0.102	0.25	0.25	0.0625	0.4	0.3	0.3	0.9557	0.1274	0.4570	0.0286	
	64200551.83	0.19	0.25	0.5	0.125	0.4	0.3	0.3	0.9557	0.2598	0.5347	0.0668	
	64200551.83	0.278	0.25	0.25	0.0625	0.4	0.3	0.3	0.9557	0.3599	0.5935	0.0371	
	57581154.6	0.102	0.5	0.25	0.125	0.4	0.3	0.3	0.8941	0.1274	0.4300	0.0538	
	57581154.6	0.19	0.5	0.5	0.25	0.4	0.3	0.3	0.8941	0.2598	0.5052	0.1263	
	57581154.6	0.278	0.5	0.25	0.125	0.4	0.3	0.3	0.8941	0.3599	0.5622	0.0703	
	50871973.11	0.102	0.25	0.25	0.0625	0.4	0.3	0.3	0.8256	0.1274	0.4000	0.0250	
MS	50871973.11	0.19	0.25	0.5	0.125	0.4	0.3	0.3	0.8256	0.2598	0.4725	0.0591	
Dynamics	50871973.11	0.278	0.25	0.25	0.0625	0.4	0.3	0.3	0.8256	0.3599	0.5274	0.0330	0.4999
	69321638.68	0.42	0.25	0.25	0.0625	0.4	0.3	0.3	0.9998	0.4831	0.6898	0.0431	
	69321638.68	0.3	0.25	0.5	0.125	0.4	0.3	0.3	0.9998	0.3816	0.6289	0.0786	
	69321638.68	0.18	0.25	0.25	0.0625	0.4	0.3	0.3	0.9998	0.2467	0.5479	0.0342	
	68935737.56	0.42	0.5	0.25	0.125	0.4	0.3	0.3	0.9966	0.4831	0.6880	0.0860	
	68935737.56	0.3	0.5	0.5	0.25	0.4	0.3	0.3	0.9966	0.3816	0.6272	0.1568	
	68935737.56	0.18	0.5	0.25	0.125	0.4	0.3	0.3	0.9966	0.2467	0.5464	0.0683	
	68460207.79	0.42	0.25	0.25	0.0625	0.4	0.3	0.3	0.9926	0.4831	0.6858	0.0429	
	68460207.79	0.3	0.25	0.5	0.125	0.4	0.3	0.3	0.9926	0.3816	0.6252	0.0781	
MondayCRM	68460207.79	0.18	0.25	0.25	0.0625	0.4	0.3	0.3	0.9926	0.2467	0.5445	0.0340	0.6221
	46370376.87	0.76	0.25	0.25	0.0625	0.4	0.3	0.3	0.7759	0.6778	0.6715	0.0420	
	46370376.87	0.68	0.25	0.5	0.125	0.4	0.3	0.3	0.7759	0.6403	0.6515	0.0814	
	46370376.87	0.6	0.25	0.25	0.0625	0.4	0.3	0.3	0.7759	0.5986	0.6293	0.0393	
	25000583.5	0.76	0.5	0.25	0.125	0.4	0.3	0.3	0.4876	0.6778	0.4975	0.0622	
	25000583.5	0.68	0.5	0.5	0.25	0.4	0.3	0.3	0.4876	0.6403	0.4808	0.1202	
	25000583.5	0.6	0.5	0.25	0.125	0.4	0.3	0.3	0.4876	0.5986	0.4622	0.0578	
	5000116.7	0.76	0.25	0.25	0.0625	0.4	0.3	0.3	0.1102	0.6778	0.2698	0.0169	
	5000116.7	0.68	0.25	0.5	0.125	0.4	0.3	0.3	0.1102	0.6403	0.2574	0.0322	
NetsuiteCRM	5000116.7	0.6	0.25	0.25	0.0625	0.4	0.3	0.3	0.1102	0.5986	0.2435	0.0152	0.4672
	58731771.6	0.7	0.25	0.25	0.0625	0.4	0.3	0.3	0.9052	0.6501	0.7336	0.0459	
	58731771.6	0.5	0.25	0.5	0.125	0.4	0.3	0.3	0.9052	0.5387	0.6700	0.0837	
	58731771.6	0.3	0.25	0.25	0.0625	0.4	0.3	0.3	0.9052	0.3816	0.5802	0.0363	
	57694402.99	0.7	0.5	0.25	0.125	0.4	0.3	0.3	0.8952	0.6501	0.7277	0.0910	
	57694402.99	0.5	0.5	0.5	0.25	0.4	0.3	0.3	0.8952	0.5387	0.6644	0.1661	
	57694402.99	0.3	0.5	0.25	0.125	0.4	0.3	0.3	0.8952	0.3816	0.5750	0.0719	
	56657034.38	0.7	0.25	0.25	0.0625	0.4	0.3	0.3	0.8850	0.6501	0.7216	0.0451	
	56657034.38	0.5	0.25	0.5	0.125	0.4	0.3	0.3	0.8850	0.5387	0.6587	0.0823	
Oracle Siebel	56657034.38	0.3	0.25	0.25	0.0625	0.4	0.3	0.3	0.8850	0.3816	0.5698	0.0356	0.6578

	69202859.97	0.652	0.25	0.25	0.0625	0.4	0.3	0.3	0.9988	0.6263	0.7751	0.0484	
	69202859.97	0.58	0.25	0.5	0.125	0.4	0.3	0.3	0.9988	0.5873	0.7517	0.0940	
	69202859.97	0.316	0.25	0.25	0.0625	0.4	0.3	0.3	0.9988	0.3967	0.6374	0.0398	
	67659255.48	0.652	0.5	0.25	0.125	0.4	0.3	0.3	0.9858	0.6263	0.7674	0.0959	
	67659255.48	0.58	0.5	0.5	0.25	0.4	0.3	0.3	0.9858	0.5873	0.7442	0.1861	
	67659255.48	0.316	0.5	0.25	0.125	0.4	0.3	0.3	0.9858	0.3967	0.6307	0.0788	
	66588691.08	0.652	0.25	0.25	0.0625	0.4	0.3	0.3	0.9767	0.6263	0.7620	0.0476	
	66588691.08	0.58	0.25	0.5	0.125	0.4	0.3	0.3	0.9767	0.5873	0.7390	0.0924	
SuiteCRM	66588691.08	0.316	0.25	0.25	0.0625	0.4	0.3	0.3	0.9767	0.3967	0.6259	0.0391	0.7222
	61957222.86	0.324	0.25	0.25	0.0625	0.4	0.3	0.3	0.9354	0.4040	0.6088	0.0380	
	61957222.86	0.25	0.25	0.5	0.125	0.4	0.3	0.3	0.9354	0.3306	0.5661	0.0708	
	61957222.86	0.212	0.25	0.25	0.0625	0.4	0.3	0.3	0.9354	0.2872	0.5409	0.0338	
	60203881.26	0.324	0.5	0.25	0.125	0.4	0.3	0.3	0.9192	0.4040	0.6003	0.0750	
	60203881.26	0.25	0.5	0.5	0.25	0.4	0.3	0.3	0.9192	0.3306	0.5580	0.1395	
	60203881.26	0.212	0.5	0.25	0.125	0.4	0.3	0.3	0.9192	0.2872	0.5330	0.0666	
	60036075.66	0.324	0.25	0.25	0.0625	0.4	0.3	0.3	0.9176	0.4040	0.5995	0.0375	
	60036075.66	0.25	0.25	0.5	0.125	0.4	0.3	0.3	0.9176	0.3306	0.5572	0.0697	
AmoCRM	60036075.66	0.212	0.25	0.25	0.0625	0.4	0.3	0.3	0.9176	0.2872	0.5322	0.0333	0.5642