

Assigning new loan projects to the business client relationship managers at a local bank office

Eric Chang  
Paul Peleuger  
Helen Saar  
Phou Sambath

SEB – the key to North-European markets

SEB has...

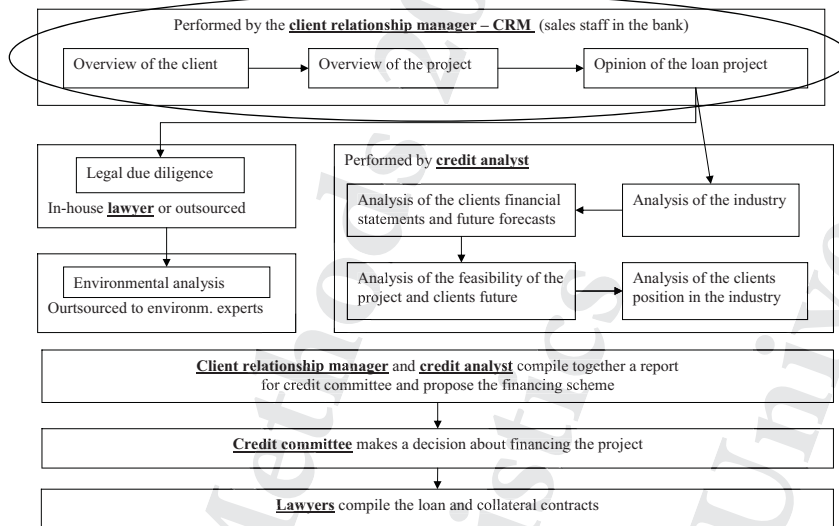
- an attractive platform
- high customer satisfaction
- stable profit growth
- several leading positions



...a strong customer base

- 2,500 customers are large companies and financial institutions
- 400,000 SME customers
- 5 million private customers

# Loan Process



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# CRM staff at the office



Employee	Hourly wage	Assigned $i$
Erki Aamer	\$35/hr	1
Karol Kõrm	\$30/hr	2
Kristina Naruzberg	\$40/hr	3
Egle Rebane	\$35/hr	4
Ivar Karnetov	\$30/hr	5
Kadri Loide	\$35/hr	6
Helen Meikar	\$40/hr	7
Taavi Gröön	\$35/hr	8
Egert Paeste	\$40/hr	9

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## Specialization of CRM staff



	Average hours per analyzing the project								
Employee→	1	2	3	4	5	6	7	8	9
Agriculture	3.0	3.5	1.5	3.5	3.0	4.0	3.5	1.5	3.5
Tourism	1.5	2.5	2.0	2.5	2.5	3.5	3.5	3.5	3.5
Food Processing	2.5	1.5	3.0	3.5	3.0	2.5	2.5	2.5	2.5
Construction	2.0	3.0	2.5	3.5	3.5	2.0	2.0	3.5	2.0
Real Estate Management	2.5	3.5	2.5	3.0	4.0	2.5	2.5	2.5	2.5
Personal Services	3.5	3.0	2.0	3.0	2.0	2.5	2.5	2.5	2.5
Energy	2.0	2.0	1.0	2.5	1.5	2.0	4.5	2.0	4.5
B2B services	2.0	3.5	3.0	2.5	3.5	2.0	3.5	2.0	3.5
Dairy processing	3.5	1.5	4.0	3.0	3.0	2.5	2.5	2.5	2.5

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## The new Projects



Project <i>j</i>	Amount (\$1,000)	Maturity	Interest/p. a.	Revenue (\$1,000)	Industry
1	1,000	3	5.5	37.80	Agriculture
2	1,500	5	7.0	207.00	Tourism
3	500	2	7.5	32.60	Food Processing
4	1,200	4	6.0	84.48	Construction
5	900	3	6.5	61.02	Real Estate Management
6	250	1	7.5	8.15	Personal Services
7	300	2	6.2	11.76	Energy
8	400	2	5.8	12.48	Agriculture
9	1,500	5	6.5	169.50	Dairy processing

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## Linear Programming Model



$$X_{ij} = \begin{cases} 1 & \text{if employee } i \text{ is assigned to the project} \\ 0 & \text{if employee } i \text{ is not assigned to the project} \end{cases}$$

where

- $i = 1, 2, 3, \dots, 9$  for the respective employee
- $j = 1, 2, 3, \dots, 9$  for the respective project

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## Employee data - sample



Employee	Industry	Ave hrs per project	hourly salary (\$)	Salary cost per project (\$)	Revenue per project (\$)	Revenue-salary cost (\$)
Erki Aamer	Agriculture	3	35	105.00	37,800.00	37,695
	Tourism	1.5	35	52.50	207,000.00	206,948
	Food Processing	2.5	35	87.50	32,600.00	32,513
	Construction	2	35	70.00	84,480.00	84,410
	Real Estate Management	2.5	35	87.50	61,020.00	60,933
	Personal Services	3.5	35	122.50	8,150.00	8,028
	Energy	2	35	70.00	11,760.00	11,690
	B2B services	2	35	70.00	12,480.00	12,410
	Dairy processing	3.5	35	122.50	169,500.00	169,378

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# LP Model 1



We look at the amount of time it would take each employee to analyze the project. Our objective function will be:

$$\begin{aligned}
 \text{Minimize} = & 105X_{11} + 52.5X_{12} + 87.5X_{13} + 70X_{14} + 87.5X_{15} + 122.5X_{16} + 70X_{17} + 70X_{18} + 122.5X_{19} \\
 & + 105X_{21} + 75X_{22} + 45X_{23} + 90X_{24} + 105X_{25} + 90X_{26} + 60X_{27} + 105X_{28} + 45X_{29} \\
 & + 60X_{31} + 80X_{32} + 120X_{33} + 100X_{34} + 100X_{35} + 80X_{36} + 40X_{37} + 120X_{38} + 160X_{39} \\
 & + 122.5X_{41} + 87.5X_{42} + 122.5X_{43} + 122.5X_{44} + 105X_{45} + 105X_{46} + 87.5X_{47} + 87.5X_{48} + 105X_{49} \\
 & + 90X_{51} + 75X_{52} + 90X_{53} + 105X_{54} + 120X_{55} + 60X_{56} + 45X_{57} + 105X_{58} + 90X_{59} \\
 & + 140X_{61} + 122.5X_{62} + 87.5X_{63} + 70X_{64} + 87.5X_{65} + 87.5X_{66} + 70X_{67} + 70X_{68} + 87.5X_{69} \\
 & + 140X_{71} + 140X_{72} + 100X_{73} + 80X_{74} + 100X_{75} + 100X_{76} + 180X_{77} + 140X_{78} + 100X_{79} \\
 & + 52.5X_{81} + 122.5X_{82} + 87.5X_{83} + 122.5X_{84} + 87.5X_{85} + 87.5X_{86} + 70X_{87} + 70X_{88} + 87.5X_{89} \\
 & + 140X_{91} + 140X_{92} + 100X_{93} + 80X_{94} + 100X_{95} + 100X_{96} + 180X_{97} + 140X_{98} + 100X_{99}
 \end{aligned}$$

We use QM softwar to solve the problem.

# Answer from QM



	x11	x12	x13	x14	x15	x16	x17	x18	x19	x21	x22	x23	x24	x25	x26	x27	x28	x29
Minimize	105.	52.5	87.5	70.	87.5	122.5	70.	70.	122.5	105.	75.	45.	90.	105.	90.	60.	105.	45.
empl 1	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.
empl 2	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
empl 3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
empl 4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
empl 5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
empl 6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
empl 7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
empl 8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
empl 9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
project 1	1.	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.
project 2	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.
project 3	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.
project 4	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.
project 5	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.	0.	0.
project 6	0.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.	0.
project 7	0.	0.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.
project 8	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.
project 9	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	1.
Solution->	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.

$$\text{Solution} : X_{12} + X_{23} + X_{37} + X_{48} + X_{56} + X_{65} + X_{74} + X_{81} + X_{99}$$

## Project information



Client	Amount (\$1,000)	Maturity	% / p.a.	Industry	Annual interest margin	Annual interest income	Total interest income from the project
1	1,000	3	5.5	Agriculture	1.26	\$12,600	\$37,800
2	1,500	5	7	Tourism	2.76	\$41,400	\$207,000
3	500	2	7.5	Food Processing	3.26	\$16,300	\$32,600
4	1,200	4	6	Construction	1.76	\$21,120	\$84,480
5	900	3	6.5	Real Estate Management	2.26	\$20,340	\$61,020
6	250	1	7.5	Personal Services	3.26	\$8,150	\$8,150
7	300	2	6.2	Energy	1.96	\$5,880	\$11,760
8	400	2	5.8	Agriculture	1.56	\$6,240	\$12,480
9	1,500	5	6.5	Dairy processing	2.26	\$33,900	\$169,500

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## Employee data - sample



Employee	Industry	Ave hrs per project	hourly salary (\$)	Salary cost per project (\$)	Revenue per project (\$)	Revenue- salary cost (\$)
Erki Aamer	Agriculture	3	35	105.00	37,800.00	37,695
	Tourism	1.5	35	52.50	207,000.00	206,948
	Food Processing	2.5	35	87.50	32,600.00	32,513
	Construction	2	35	70.00	84,480.00	84,410
	Real Estate Management	2.5	35	87.50	61,020.00	60,933
	Personal Services	3.5	35	122.50	8,150.00	8,028
	Energy	2	35	70.00	11,760.00	11,690
	B2B services	2	35	70.00	12,480.00	12,410
	Dairy processing	3.5	35	122.50	169,500.00	169,378

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## LP Model 2



We look at the revenue of each project minus the cost of each employee analyzing that project. Our objective function will be:

$$\begin{aligned}
 \text{Maximize} = & 37,695X_{11} + 206,947.5X_{12} + 32,512.5X_{13} + 84,410X_{14} + 60,932.5X_{15} + 8,027.5X_{16} \\
 & + 11,690X_{17} + 12,410X_{18} + 169,377.5X_{19} + 37,695X_{21} + 206,925X_{22} + 32,555X_{23} + 84,390X_{24} \\
 & + 60,915X_{25} + 8,060X_{26} + 11,700X_{27} + 12,375X_{28} + 169,455X_{29} + 37,740X_{31} + 206,920X_{32} \\
 & + 32,480X_{33} + 84,380X_{34} + 60,920X_{35} + 8,070X_{36} + 11,720X_{37} + 12,360X_{38} + 160,340X_{39} \\
 & + 37,677.5X_{41} + 206,912.5X_{42} + 32,477.5X_{43} + 84,357.5X_{44} + 60,915X_{45} + 8,045X_{46} \\
 & + 11,672.5X_{47} + 12,392.5X_{48} + 169,395X_{49} + 37,710X_{51} + 206,925X_{52} + 32,510X_{53} + 84,375X_{54} \\
 & + 60,900X_{55} + 8,090X_{56} + 11,715X_{57} + 12,375X_{58} + 169,410X_{59} + 37,660X_{61} + 206,877.5X_{62} \\
 & + 32,512.5X_{63} + 84,410X_{64} + 60,932.5X_{65} + 8,062.5X_{66} + 11,690X_{67} + 12,410X_{68} + 169,412.5X_{69} \\
 & + 37,660X_{71} + 206,860X_{72} + 32,500X_{73} + 84,400X_{74} + 60,920X_{75} + 8,050X_{76} + 11,580X_{77} + 12,340X_{78} \\
 & + 169,400X_{79} + 37,747.5X_{81} + 206,877.5X_{82} + 32,512.5X_{83} + 84,357.5X_{84} + 60,932.5X_{85} + 8,062.5X_{86} \\
 & + 11,690X_{87} + 12,410X_{88} + 169,412.5X_{89} + 37,660X_{91} + 206,860X_{92} + 32,500X_{93} + 84,400X_{94} \\
 & + 60,920X_{95} + 8,050X_{96} + 11,580X_{97} + 12,340X_{98} + 169,400X_{99}
 \end{aligned}$$

$$\text{Solution: } X_{12} + X_{23} + X_{37} + X_{48} + X_{56} + X_{65} + X_{74} + X_{81} + X_{99}$$

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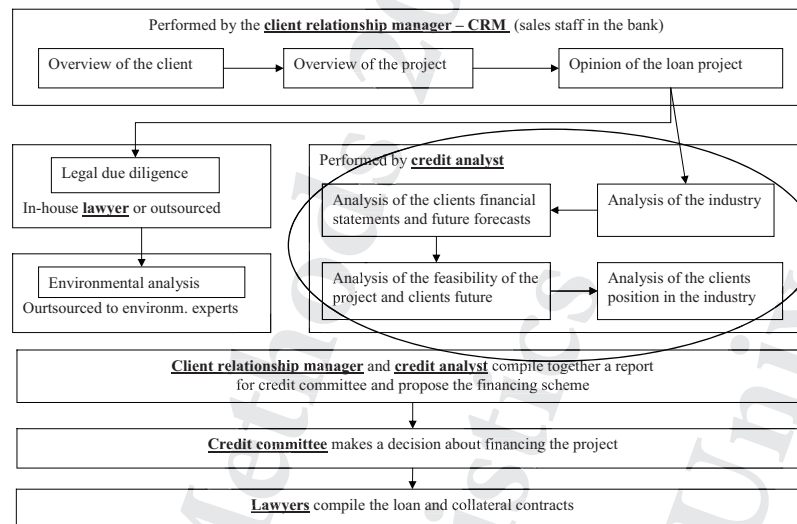
## Our solution:



$j$	Amount (\$1,000)	Materiality	% p.a	Revenue (\$1,000)	industry	Employee assigned to the project ( $i$ )	Ave hrs per project	Salary per project	Revenue - salary
1	1,000	3	5.	37.80	Agriculture	Karol Kõrm (2)	3.5	\$105.00	\$37,695
2	1,500	5	7	207.00	Tourism	Kristina Naruzberg (3)	2.0	\$80.00	\$206,920
3	500	2	7.	32.60	Food Processing	Helen Meikar (7)	2.5	\$100.00	\$32,500
4	1,200	4	6	84.48	Construction	Taavi Gröön (8)	3.5	\$122.50	\$84,358
5	900	3	6.	61.02	Real Estate Management	Kadri Loide (6)	2.5	\$87.50	\$60,933
6	250	1	7.	8.15	Personal Services	Ivar Karnetov (5)	2.0	\$60.00	\$8,090
7	300	2	6.	11.76	Energy	Egle Rebane (4)	2.5	\$87.50	\$11,673
8	400	2	5.	12.48	Agriculture	Erki Aamer (1)	3.0	\$105.00	\$12,375
9	1,500	5	6.	169.50	Dairy processing	Egert Paeste (9)	2.5	\$100.00	\$169,400
<b>Total Revenue:</b>				<b>\$624.79</b>	<b>Total:</b>			<b>\$847.50</b>	<b>\$623,943</b>

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## Loan Process



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## Some considerations



1. How will the **younger/newer staff gain knowledge and experience** if the projects are only assigned to the CRM staff who would be fastest on analyzing it?
2. In addition to the time it takes to analyze the project, the **quality** of the analysis also very important in banking.
3. The model could be made more complicated by taking into consideration exact free time each employee has available for new projects → this way the project may not go for the most efficient staff just because they do not have time at the moment.

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## Some considerations, *cont.*



4. There are also **human factors** – the CRM staff and credit analyst need to work closely together and some teams just may work better than others, so even though separately CRM staff and credit analyst may be most efficient, but if they work together they will not make a good team.
5. In addition to the industry considerations in analyzing the loan project the geographic location of it is important. One CRM staff may know the region better than the other.
6. It is important that the solution is based on **estimates** and the real results (the time it takes staff to analyze the project and the income from the project) can be much different.

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Thank You!