Interim Report – Team Túlka

MS-E2177 Seminar on Case Studies in Operations Research

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Table of Contents

1. Objectives

The objective of our project was refined to building a system dynamics model for Tulka to assess the outcome of different growth initiatives. The model serves as a supporting tool in Tulka's decision-making process regarding the entering to new market areas. The idea is that the model takes estimated input parameters that it uses to create scenarios. Our aim is to build a model that depicts one new market as well as the Finnish market and is easy to expand to cover multiple new markets. Chapter 3 explains the input parameters and the revenue and cost components that they affect. The input sheets are linked to Profit and Loss (P&L) calculations which are also automatically provided in the model. The Finnish and German P&L-statements are aggregated for the Tulka Group -level. Finally, the model can be further extended and modified to include markets that are relevant to Tulka's business in the future. The model was built iteratively based on Tulka's feedback.

2. Tasks and Schedule

2.1 Updated list of tasks

Introduction to Túlka and scoping of the project (12.1.-2.2.2018) - Done

Understanding the business through data analysis (24.1.-23.2.2018) - Done

To get acquainted with Túlka's operative data from year 2017 to understand how capable Túlka is to answer the demand and serve its customers currently. This provides insight on how well the company is equipped to expand into new markets and how it should probably approach the expansion.

Literature Review (12.1.-) – Still in progress

Conducted throughout the project, whenever external insight is seen beneficial. Concentrating on platform ecosystems, dynamic systems and expansive growth strategies.

Project plan development (14-21.2.2018) - Done

Project plan is developed and written to describe the direction and the status of the project.

Developing the dynamic system model (15.2.-5.4.2018) - Done

We have built the System Dynamics Model described in detailed in chapter 3. The aim was to make the model as granular as possible without losing its flexibility in assessing different growth strategies and new market entry models.

Defining the required parameters to reach desired financial objectives (12-18.4.2018) – Still in progress

Forming an educated recommendation on the required parameters for Tulka to reach its desired financial goals.

Interim report development (4-11.4.2018) - Done

Interim report is developed and written to reflect the progress and results acquired at the point of time.

Final report development (30.3.-16.5.2018) – Still in progress

Final report is developed and written to describe the project and its results in their entirety.

2.2 Schedule

Figure 1 presents our tasks and schedule. The schedule has remained almost the same compared to the one in the project plan. We have met the schedule well during the project and no delays have occurred. We have two tasks remaining: to form an educated recommendation for Túlka and to create the final report. We might still need to do some literature review as well.

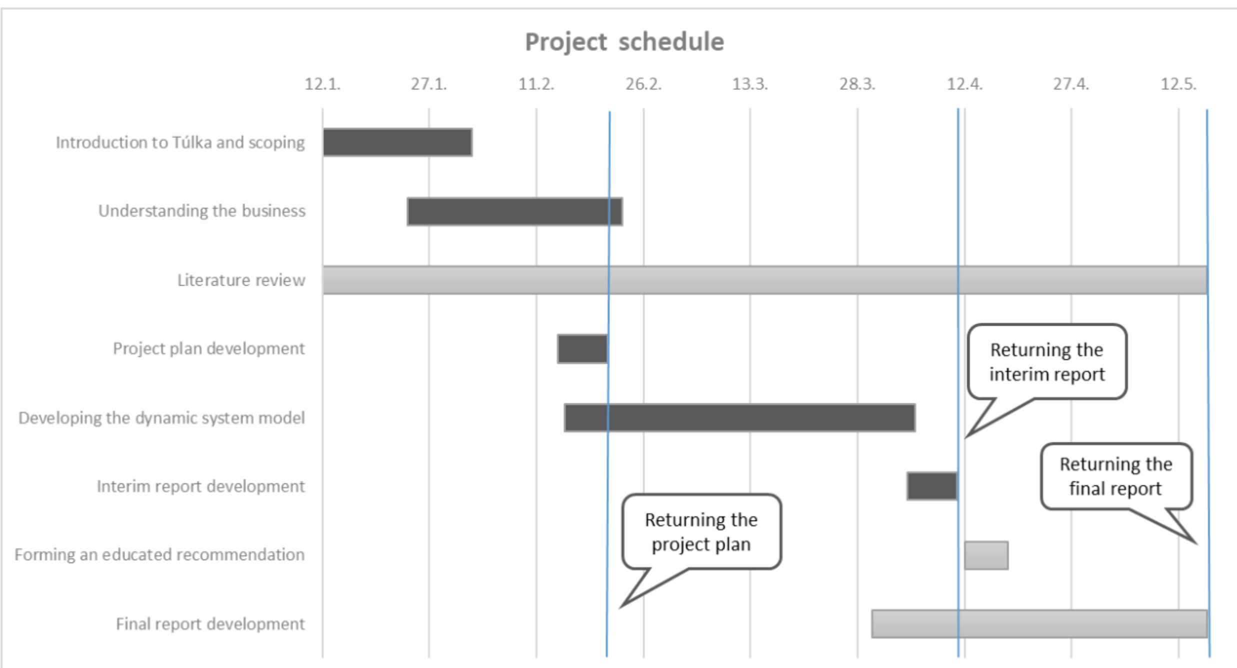

Figure 1. Updated project schedule (dark gray bars represent completed tasks)

3. Model components

3.1 Revenue components

In the model, the total revenue is the sum of three different revenue components. These revenue components are assumed to cover all revenue streams of Tulka's business. The equation for the total revenue is presented below.

$$TR = R_{interpretation} + R_{licencing} + R_{client\ acquisition}$$

The first revenue component, revenue from interpretation, represents the revenue from the interpretation business. The revenue depends on the pricing model, the relative share of differently priced calls and the total number of calls. It is assumed that the pricing model is either a staircase model, which is currently used or a linear or a constant model. The model gets the relative shares and prices as inputs. The equations are as follows

Constant pricing:

Constant pricing model means that the price per hour is a constant value and is not dependant on the duration of the interpretation. Total revenue is calculated as follows:

$$R_{interpretations} = n_{interpretations} \sum_{i=1}^{3} s_i d_i P_i$$

where $n_{interpretations}$ is the total number of interpretations, s_i is the share of interpretations for each interpretation type (basic, premium or discount) ($s_1+s_2+s_3=1$), d_i is the average duration of interpretation for each interpretation type and P_i is the fixed price level (€/h) for each interpretation type.

Linear pricing:

Linear pricing means that the price level is linearly dependant (decreasing in this case) on the duration of the interpretation. The total revenue with linear pricing is therefore:

$$R_{interpretations} = n_{interpretations} \times \sum_{i=1}^{3} \left(s_i \times \int_{0}^{\infty} f(x) P_i(x)\, dx \right)$$

where f(x) is the probability density function for interpretation duration, $P_i(x)$ is the linear pricing function for each of the three interpretation types and s_i is the share of interpretations for each interpretation type.

The total number of interpretations done through Tulka's platform is defined as the number of clients and the number of interpretations per client. The equation is as follows

$$n_{interpretations} = n_{clients} \times n_{interpretations\ per\ client}$$

Based on our analysis, the distribution of interpretation duration for the linear pricing follows a gamma distribution. Gamma distribution is a continuous distribution function with parameters shape (α) and rate (β) (Hosch, 2009). It is commonly used, for example, in engineering, business and meteorology models (Hosch, 2009). We estimated the shape and rate parameters with transaction data from 2017 and the estimated values are 1.249133495 and 0.001127922 respectively. The fit with this distribution was examined with R, and the fitting plots are shown in Figure 2.

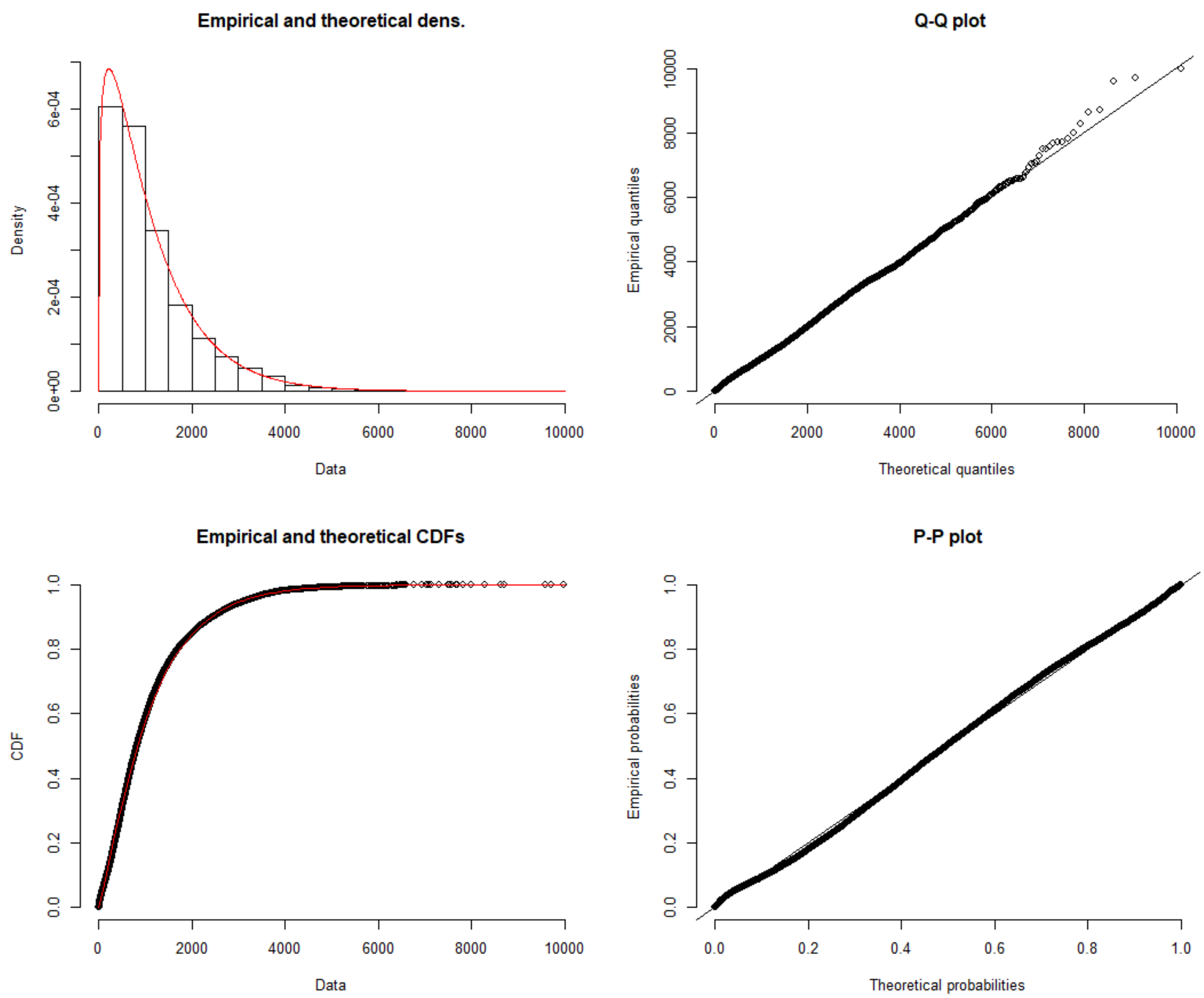

Figure 2. Fitted plots for Gamma distribution

The theoretical distribution is not implemented in our model, at least for now. We have used a discrete distribution which is derived directly from 2017 data. We will discuss with Túlka whether they want to use theoretical distribution or not. However, now that we have identified the distribution and the function for revenue it is easy to implement if necessary. The choice between the two options won't make a large impact to the model output so it is only a minor detail.

Staircase:

Table 1. Example of staircase pricing for 2018

Duration	Basic	Premium	Discount

under 5 min	10	12	10
over 5 - 10 min	15	18	12
over 10 - 15 min	25	30	16
over 15 - 30 min	37	44	28
over 30 - 45 min	55	66	43
over 45 - 60 min	60	78	47
over 60 min	65	78	55

The revenue from the staircase pricing is calculated as follows

$$R_{staircase} = \sum_{i=1}^{7} P_{i,Basic} n_{interpretations} p_{i,Basic} + \sum_{i=1}^{7} P_{i,Premium} n_{interpretations} p_{i,Premium} + \sum_{i=1}^{7} P_{i,Discount} n_{interpretations} p_{i,Discount}$$

In the staircase revenue, the total number of interpretations is divided into basic, premium and discount prices. The respective and relative proportions (p) of these price-categories for each duration range are calculated based on 2017 data. P is the price of the interpretation for the respective duration-range and price-category. Table 1 shows an example of a staircase pricing matrix.

The average number of clients for a year is estimated to be the linear mid-point between the number of clients at the end of the year and at the end of the previous year. Thus, the subtraction of these end-of-year number of clients is divided by two and the result is added to the end of year client count from the previous year.

$$n_{clients,t} = n_{clients\ year\ end,t-1} + \frac{\mathrm{n}_{\mathrm{clients\ year\ end,t}} - n_{clients\ year\ end,t-1}}{2}$$

The second revenue component is revenue from licensing. The logic with the licenses is that customers need to pay a fixed fee for each account they wish to have. Therefore, revenue from the licenses is the product of the average number of licenses per customer, average number of customers at time t and price per license. The equation is as follows

$$R_{licensing} = n_{license\ per\ client} \times n_{clients\ on\ average,t} \times P_{license}$$

The third revenue component is revenue from client acquisitions. The idea behind this is that customers would have to pay a certain initial fee in order to join the platform. The revenue from this activity is calculated by multiplying the number of new clients with the price of the initial fee. The equation is as follows

$$R_{client\ acquisition} = \left(n_{clients\ year\ end,t} - n_{clients\ year\ end,t-1}\right) \times P_{client\ acquisition}$$

3.2 Cost components

Tulka's total costs consist of variable and fixed costs.

$$C_{total} = C_{variable} + C_{fixed}$$

Equation A describes Tulka's variable costs which are derived from the interpreter costs. Tulka advised that other variable costs are so minimal that they do not have to be included in the model. Thus, variable cost is defined by the cost that the interpreter takes in the transaction. Three different parties can perform the interpretation: an interpreter from Tulka's direct payroll, a freelance interpreter or a partner company's interpreter. The cost from each of these potential parties can vary and thus Tulka's total variable cost is the sum of the costs inflicted by each of these three interpreter parties. Tulka pays their interpreters or their partners according to their staircase model and that has been implemented into our model. The variable cost equation is as follows.

$$\begin{aligned} C_{variable} = {} & n_{payroll\ interpretations} \times C_{payroll\ interpretation} \\ & + n_{freelancer\ interpretations} \times C_{freelancer\ interpreation} \\ & + n_{partner\ interpretations} \times C_{partner\ interpretation} \end{aligned}$$

The number of interpretations performed by each of the three interpreting parties are defined through equations B, C and D. In equation B, β defines the share interpretations performed by Tulka's partner company's interpreters. In equation C, α defines the share of interpretations performed by freelancer interpreters. The rest of the interpretations fall to Tulka's payroll interpreters. The equations for number of interpretations per interpreter party are as follows

$$n_{partner\ interpretations} = n_{interpretations} \times \beta$$

$$n_{freelancer\ interpretations} = n_{interpretations} \times \alpha$$

$$n_{payroll\ interpretations} = n_{interpretations} \times (1 - \beta - \alpha)$$

Tulka's fixed cost consists of six components. The cost of acquiring and interpreter, admin personnel costs, rent & equipment costs, marketing costs, new location establishment costs and other fixed costs are all inputs that can be entered into the model based on Tulka's estimations. The fixed costs equation is as follows

$$C_{fixed} = C_{interpreter\ acquisition} + C_{admin\ personnel} + C_{rent\ \&\ equipment} + C_{marketing} + C_{new\ location\ establishment} + C_{other\ fixed}$$

The number of interpreters required drives the total interpreter acquisition cost. This cost only applies for interpreters that Tulka directly acquires to their own payroll. This cost occurs when Tulka has to certify and validate interpreters to serve clients such as government officials, who require certain certifications. Depending on the share of interpretations carried out by freelancers and partner interpreters, the need for these acquisitions is defined. The increase in total interpreter capacity requirements derives from the difference of interpreters needed this year and the previous year. However, as described above only the payroll interpreter acquisition triggers the cost. The equation is as follows

$$C_{interpreter\ acquisitions} = \left(\max(n_{interpreters\ required,t} - n_{interpreters\ required,t-1}, 0)\right) \times (1 - \alpha_t - \beta_t) \times C_{average\ per\ interpreter}$$

The total amount of interpreters required to meet the demand is the total amount of interpretations done through Tulka's platform divided by the number of interpretations performed by an interpreter. The equation is as follows

$$n_{interpreters\ required} = \frac{n_{interpretations}}{n_{interpretations\ per\ interpreter}}$$

Administrative personnel consist of all employees other than the interpreters working for Tulka. The total fixed cost caused by administrative personnel is derived from the number of these employees and their salaries. The equation is as follows

$$C_{admin\ personnel} = n_{admin\ personnel} \times C_{average\ admin\ salary}$$

Finally, the earnings before interest, taxes, depreciation and amortization (EBITDA) is calculated in the model by subtracting total costs (variable costs + fixed costs) from total revenue. The equation is as follows

$$EBITDA = R_{total} - C_{total}$$

3.3 Overview of the System Dynamics Model

The systems dynamics model presented in Figure 2 presents the links all of the discussed components together and their joint effect on net income.

Figure 2. Systems Dynamic Model

4. Project risks

The Table 2 describes the identified risks, their perceived probabilities, impacts and actions that can be taken to reduce the potential negative outcomes. The risks and their probabilities to materialize have changed a little since the project plan was written. The risk to face issues due to having difficulties in matching schedules between team members have increased in probability, as many of our team members have started or will soon start working full time. This also brings challenges to arrange meetings with Tulka's representatives. Our team will have to be more flexible in terms of accepting the reality that not everyone can be in every meeting and also, we might have to work more during the weekends to finish this project. In the project plan we identified the setting of too broad scope for the project to be the most prominent risk. However, we were soon after the project plan able to narrow the scope down pretty well and believe that we are on the right path on producing meaningful value to Tulka. Otherwise the risk profile of our project hasn't changed since the project plan was created.

Table 2. Identified risks

Risk	Probability	Impact	Countering actions
Unmatching schedules between team members	High	Coordination of tasks is difficult and might cause unbalanced workload among team members	Planning meetings for weekends and allowing more flexibility for team members
Conflicts between team members regarding the final output of the project	Low	Quality of the project might decrease if all members are not motivated to achieve the final output	Finding consensus for the output by iteratively discussing the most value-adding aspects for the company
Team member falls ill	Medium	Workload grows for the remaining team members	Team members are allowed to skip group meetings, if they feel that they should recover at home
The project scope is too wide	Low	The aspects of the company's assignment are not examined in sufficient depth	Stick to the already defined project scope that we have been addressing
The output of the project is not valuable to the company	Low	The company does not obtain value and the time of personnel might be wasted	The advancement and direction of the project is communicated clearly to the company in order to assure focusing on relevant aspects
Losing or accidently sharing confidential information	Low	Serious legal consequences for the students and large possible financial losses for the company	Data is stored in a location, which is only accessible by the parties involved

5. References

Hosch, W. L. 2009. *Gamma distribution*. Encyclopedia Britannica. Available at: https://www.britannica.com/science/gamma-distribution. [Accessed 11 April 2018]