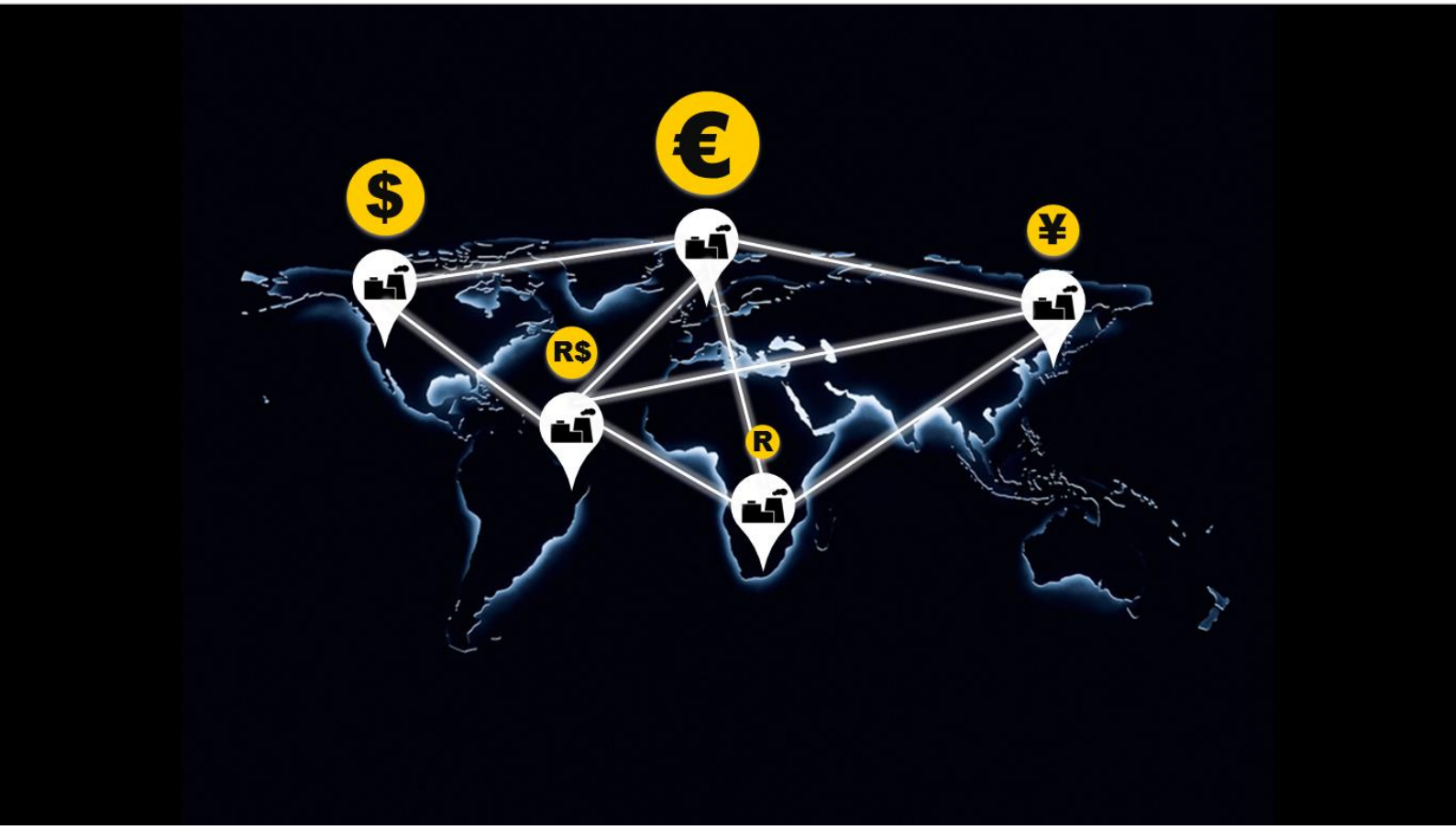
RisqLabs ICRM: Integrated Currency Risk Management



The customer

Shipping company N.N is one of the three biggest shipping companies worldwide. Besides their cargo business with standard containers, N.N also operates a cruise business branded "N.N. Cruises" and headquartered in Europe. The cruise business is the object of this case study.

N.N Cruises is a European private company with over 15.000 employees worldwide and operates a fleet of twelve state-of-the-art cruise ships. Their cruise ships travel to eight different destinations, one of which is South Africa. South Africa cruises are offered seasonally in the time period from October to March and they can be booked from any of the 45 N.N Cruises branches worldwide.

Revenues and margins

For the destination area South Africa, cruises that are booked are, among others, paid in the currency of "South African rand" (ZAR). The bookings that guests transacted in ZAR amounted to the equivalent of US $80 million in the fiscal year 2013/14. The company projects a profit margin of 8%-12%, an average of 10%. The revenue that N.N. Cruises accounts for in ZAR is the object of this case study.

Background

When N.N. Cruises receives customers' ZAR payments, the company has to exchange the ZAR-denominated amounts into US $ (USD). The reason for the currency exchange transaction: The cruise operator's costs, which to a large extent, do not arise in ZAR, but in USD; for example, harbor fees or fuel - a ton of marine diesel currently costs about US $900. Therefore, USDZAR is the relevant currency pair for N.N. Cruises' hedging activities related to their South African business. The company plans the costs, which accrue in USD, ahead of every South Africa season, assuming that the revenue (in ZAR) as well as the costs (in USD) will reach a certain volume. In order to generate a turnover n in USD, N.N Cruises has to obtain a sales figure m in ZAR. The USD revenue is therefore dependent on two values: (1) the ZAR revenue, and (2) the USDZAR exchange rate.

The specifities of travel booking: Advance payment and final payment

Just like for other travel bookings, a peculiarity applies to N.N. Cruises as well: Customers make an advanced payment of 20% of the travel price in ZAR within five days of their booking; the final payment of 80% shall be paid by 60 days before the start of the cruise.

However, some customers cancel their travel bookings. Thereby, they do not only lose their advance payment, but depending on the effective date of the cancellation - earlier or later before the cruise shall take place - the customers can be obligated to pay an additional compensation to N.N. Cruises. These cancellation fees range from 35% to 95%. For N.N. Cruises, this means a partial loss of the total travel price.

The problem: Exchange rate fluctuations

Because the ZAR advanced payment is "only" 20% of the total travel price, N.N. cruises is not able to exchange the total travel price into USD at the time of booking and, therefore, to lower the exchange rate risk to virtually zero upon the customers' bookings. The company has not yet received the total travel price. Instead, N.N. Cruises has to wait for up to four months before receiving the final payment. By then, the costs are not the only *top line* figure of the company's income statement that is changing dynamically - e.g. the price of marine diesel could rise in the meanwhile -, but the USDZAR currency price fluctuates as well, having a direct impact on the company's revenues. Treasurers refer to this kind of risk as the *transaction risk*. The customers' South Africa travel bookings are transacted and recorded, but they become only become effective payments at a later point in time. Meanwhile, the ZAR price fluctuations directly affect N.N. Cruises' profit margin.

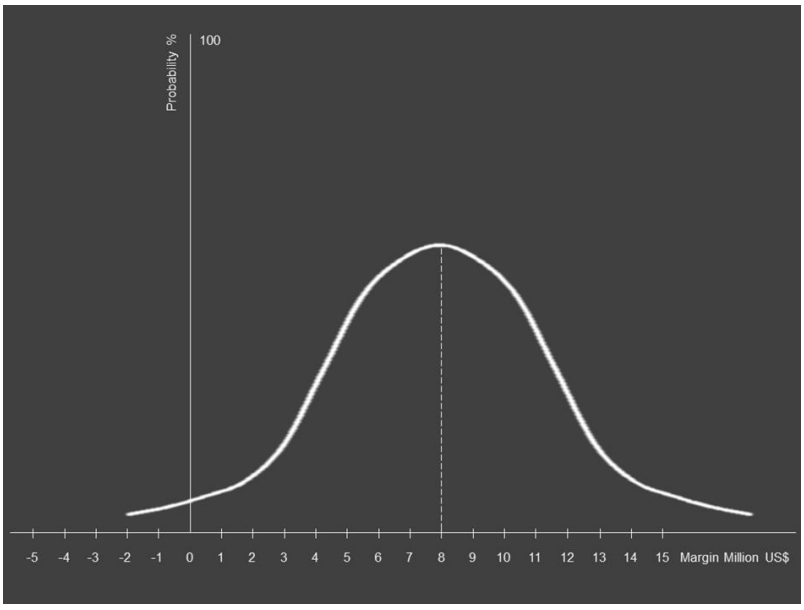


Image 1: Idealized "normal case" of the unsecured revenue recognition (Hedge = 0). N.N. Cruises projects an average profit margin of 10%. With a ZAR revenue of the equivalent value of US $80 million, the projected profit amounts to US $8 million. The normal distribution, as represented by the bell curve, clarifies that more, or less, that US $8 million can be achieved with a certain probability. Note: The distribution shown implies no projections about unfavorable exchange rate fluctuations.

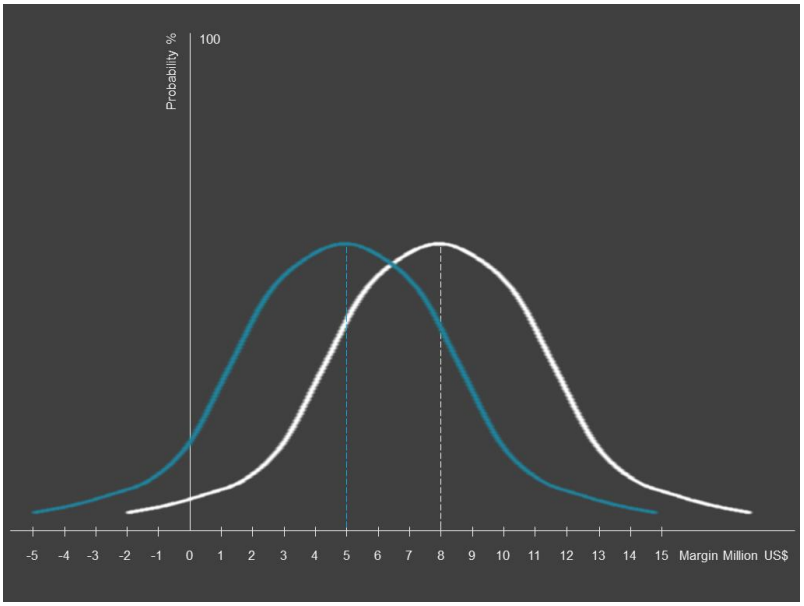


Image 2: Blue Graph: Idealized "normal case" of profit realization, however under the assumption that the ZAR will depreciate against the USD. Because of the depreciation the US $8 million margin could, for example, shrink to only a US $5 million margin. With this comes an increased probability that the margin is going to be even smaller, because the entire curve is shifted further to the left and into the loss area.

Depending on the rate of the currency pair USDZAR, N.N. Cruises' profit or loss can be substantial. De facto, for their South Africa business, the loss has been getting higher in the past. Since June 25th, 2011, the ZAR has depreciated from 0.14548 by almost 35% to 0.09432 (as of June 10th, 2014) in relation to the USD.

Image 3: 5-year chart of the ZARUSD price move, starting on June 15th, 2009. After an initial phase of making gains against the USD, the ZAR has depreciated against the USD by about 35% in three years.

The below table clarifies the relevance of this effect on N.N. Cruises' revenues. In order to achieve the equivalent of a constant US $80 million revenue, the company would have had to increase its annual sales activities in ZAR as follows:

Reference date	Revenue in USD, converted	Sold trips in ZAR (rounded)	Necessary annual sales growth
June 10th, 2011	80 million	538 million	N/A
June 10th, 2012	80 million	667 million	23.97%
June 10th, 2013	80 million	796 million	19.34%
June 10th, 2014	80 million	847 million	6.41%

In other words, the company's sales department would have had to increase its ZAR revenues by more than 57% from June 2011 to June 2014 in order to achieve a constant annual USD-denominated revenue of US $80 million and to compensate for the 35% currency loss of the ZAR against the USD. At the same time, the N.N. Cruises' customers could be pleased, because up until the final payment was made the company did nothing less than assume its guest's currency risk. It acted as though this was an additional transaction, besides the transportation obligations, for its customers; an insurance transaction that secured the South Africa cruise prices for its guests.

How N.N. Cruises currently acts against currency risks

It stands to reason that there are limits to the sales increase and that N.N. Cruises cannot bear its customers' currency risks permanently. On the other hand, the currency risk cannot be entirely transferred onto the customer; after all, N.N. Cruises cannot unrestrictedly raise the travel price of cruises to the South African region. At a certain amount, the travel price can no longer compete. N.N. Cruises faces a dilemma and rightly asks itself the question if and how exchange rate uncertainties are controllable.

Because the decision about how to approach the hedging of its ZAR currency risks is complex, N.N. Cruise has not undertaken any hedging activity in the past at all. Traditionally, the currency hedging business is in the hands of banks. Banks offer financial instruments that promise to hedge currency exchange risks, for example currency forwards (FX Forwards) or options, in short *derivatives*. In other words: Banks sell financial instruments, more or less expensive, more or less suited, in order to neutralize exchange rate uncertainties. In fact, multinational corporations groan under the load of their currency losses, even though they buy financial instruments from banks. The conventional approach does not work as properly as it was thought to. Practice has shown that some of the sold financial instruments for exchange rate hedging are not at all suitable, or their size is improper, so that they become a risk themselves. As a result, mathematically unjustifiable

and economically useless “hedging strategies” arise. Instead of optimal risk management, rules of thumb are being applied. In order to hedge the exchange rate risk in 180 days, companies buy financial instruments that secure 50% of the base value. The future exchange rate, which is taken as a basis for the use of the financial instrument, is guessed by asking the crystal ball every three months. Furthermore, another problem arises because the banks offer companies in need the financial instruments from currency “hedging” that the banks themselves can profit from the most. The costs are hidden in the total price of the financial instrument and are very unclear for the companies. Therefore, a traditional hedging can be expensive for a company. As a general rule, companies are not adequately secured as a result of this.

From the perspective of a data scientists, a specialist of the digital big data world, one can confidently say: With the digital revolution and Industry 4.0 technologies, there are better risk management approaches than the banker’s standardized sale. Big data technologies enable effective hedging for the first time. Not only the enormous computing capacity and the increased availability of risk-relevant data contribute to that. Mathematical models, which are the basis of every big data hedging strategy, are essential. They will be supplied with real-time corporate and market data and calculated by parallel supercomputers in a very short time.

Today, a company manages its currency risk ideally by using these kinds of hedging algorithms. A hedging algorithm is a calculation procedure, which is based on a mathematical model that considers the company’s specific operational characteristics as well as the external influencing factors, and which calculates an adaptive, mathematically optimal, daily pro rata hedging strategy. Banks are of little or no help when it comes to algorithmic hedging. The bank’s look at its customers’ specific operational characteristics is misaligned, because they offer neither the knowhow, nor the mathematical expertise. Companies that still hedge their currency risks with the traditional financial instruments today did not have any other choice.

The basic solution: One step hedging

A currency loss could be prevented completely if N.N. Cruises took in 100% of the ZAR traveling price and exchanged it for USD. In that case, the company would have 100% of its revenue realized immediately and it could spend the received USD on fuel, salaries, or other dollar denominated costs. However, because of the inimitableness of travel booking, with advance payment/final payment/cancelation, this approach is not realistic.

Theoretically, a similar result could be achieved if the company took up a ZAR loan for the recorded but not yet paid ZAR travel bookings and exchanged the credited amount for USD. The ZAR loan could be repaid with the outstanding ZAR final payments. That is the basic assumption. However, when looking at it in more detail, other variables that have to be taken into consideration emerge. Obviously, interests have to be paid for the ZAR credit. While the prime rate at a South African issuing bank is set at 5.5% (as of June 10th, 2014), a commercial credit institution charges about 9% annual interests for a ZAR credit, or 4.5% interests for half the year respectively, during the season when N.N. Cruises offers South Africa cruises. With an average profit margin of 10%, N.N. Cruises would be left with a significantly smaller profit from the South Africa business. If cancelations were to be taken into consideration, the meager remainder would be weak as well. The credit transaction would turn into a loss if N.N. Cruises were to "over hedge" and take out a ZAR loan that was higher than the travel bookings that were made.

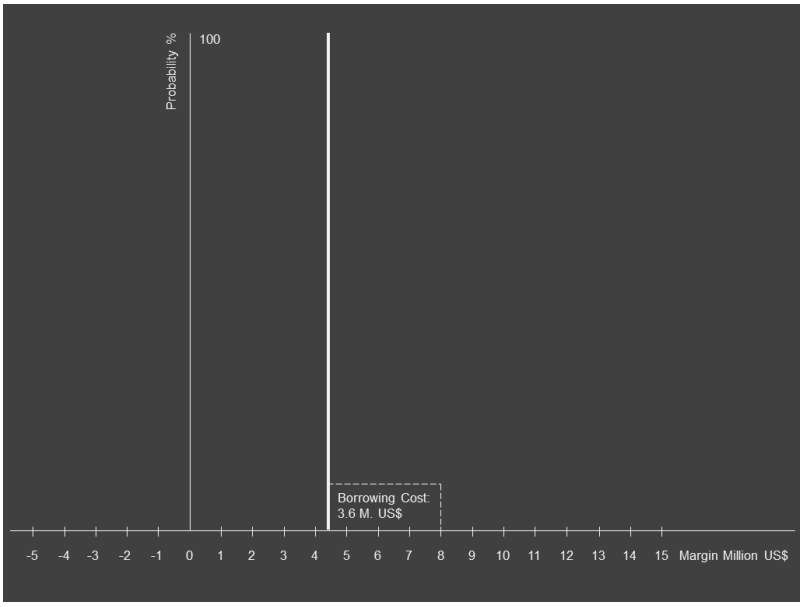


Image 4: "Normal case" of profit realization if N.N. Cruises were to take out a ZAR loan in the amount of the booked South Africa cruises and exchange it for USD right away. The interest on credit narrows the margin by US $3.6 million to a remainder of about US $4.4 million, in the best case, again without the assumption of a negative exchange rate development.

The optimal adjustment of the ZAR loan alone could lower the N.N. Cruises' costs of a ZAR loan. In our example, an optimization would lead to a ZAR loan equal to 84% of the planned revenue. The loan will be taken out one time at the beginning of the season.

Yet this simple calculation, without big data and its efficient models, helps. It starts with a point in time *t* (today) and makes assumptions about the risk of a future point in time t_1.

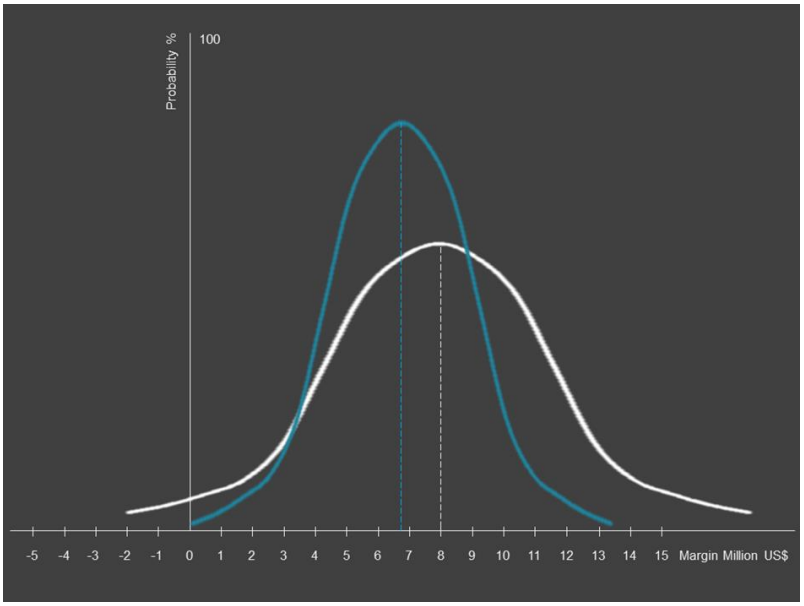


Image 5: "Normal case" of profit realization if N.N. Cruises takes out a ZAR loan equal to 84% of the booked ZAR sales and exchanged it for USD right away (blue curve). The interest on credit narrows the margin, but by less than with a 100% loan in ZAR.

It is evident that the solution of the "one step" is still far from optimal. The multi-step hedging, the "daily adjustment" of exchange hedging, gets much closer to optimal hedging. It is dependent on many of the personalized revenue and cost models variables, as well as on the market model with its current exchange rates in real-time.

Multi-step hedging: The big data solution for CFOs

N.N. Cruises wants to obtain more control over its USDZAR currency exchange risk. The cruise company has to decide:

1. Does N.N. Cruises want to accept a certain loss of 4.5%, brought about by the interest payments for a ZAR loan, per South Africa season?

2. Does N.N. Cruises want to accept an uncertain loss of an average of 6% per South Africa season that, with the probability *P*, could also turn into a gain caused by the currency fluctuations?

3. Does N.N. Cruises want to buy a financial instrument from the bank, whose impact and effectiveness are unclear?

4. Or is there an optimal way that considers all of the variables, the interest burden of a loan, as well as the likeliest exchange rate, and the company's own revenue and expense characteristics?

For an optimal hedging strategy, N.N. Cruises introduces a modern algorithmic system, which uses mathematical models, supercomputers, and big data obtained from the currency market. The model does not eliminate the use of derivatives if they fulfill the model's overall efficiency criteria.

Big data just started to be on everyone's lips. On the one hand, big data, as a term, is the invention of marketing strategists and refers to the storage and analysis of vast quantities of data, as it has only been available in the world for the past three years. On the other hand, big data is more than just a marketing hype. Large-scale mathematical models are able to calculate a company's currency exchange risk in real-time for the first time. A company's revenues and expenses are gathered on a daily basis, similar to streaming prices and qualitative data from the currency market, plus the prices that market participants are willing to pay for options. The choice of hedging tools and the hedged amount are being adjusted daily based on the current data. High-speed computers, an adaptive hedge controller, which is an "intelligent machine", and a custom revenue and cost model for N.N. Cruises allow for such personalized hedging strategy. Thereby, the hedging is carried out in two steps:

1. A mathematical model, the *H*, calculates the optimal values for the hedging of revenue and profit.

2. An algorithm, *Deal:IQ*, buys or sells the instruments, as calculated by *Hedge:IQ*, from N.N. Cruises' house bank or from a foreign exchange aggregator at the best price ("best price execution").

Hedging in real-time: Hedge:IQ

The Hedge:IQ is an automatic, electronic "accountant." Its task is to report the daily accounting transaction of USD and ZAR amounts during the South Africa cruise season. Thus, it has to report the incoming payments, outgoing payments, or the exchange operations in these two currencies. Hedge:IQ is composed of various compartments, "cells" of individual currencies, and denominated in the company's balance sheet currency. For the

currencies contained in the Hedge:IQ compartments, the daily time weighted average prices "TWAP" are determined.

Multi-agents and revenue and cost models

Hedge:IQ is integrated with multiple independent software agents, which provide the model with certain information in order to keep the currency compartments up to date on a daily basis. The software agents prepare company specific data for revenue and expenses and provide Hedge:IQ with N.N. Cruises' internal *private state*. External influences are being monitored by other software agents, which prepare external data about the currency market or correlated assets, e.g. the prices for marine diesel - the external *opponent state*.

1. A revenue agent provides data of the N.N. Cruises business activity on a daily basis. Alternatively, weekly updates are possible. This includes newly recorded travel bookings, cancelations, but also vacation periods, the destination area's weather data, and the like. The revenue agent can be fed with other data sources and reflects the N.N. Cruises' revenue model.

2. A cost agent provides daily updated external data; fuel prices or interest for ZAR credits are among the most prominent data.

3. The FX agent obtains external USDZAR option prices and simulates million fold how the currency pair is most likely to develop in the future. The closer the option barrier gets, the more the price funnel narrows to a specific market price.

Simulation of the company's cash pool

All data that is provided by the agents is delivered to the Hedge:IQ model. Subsequently, Hedge:IQ calculates how the N.N. Cruises' cash pool develops daily, with a large-scale simulation. Thereby, each variable's subtle dependences are taken into account. The closer it is to the start of a cruise, the less that can be done to manage the development of sale. The outcome of the simulation is an allocation, a histogram of possible developments of sales based on all the variables and values that are crucial for N.N. Cruises' operational activities.

Training and live operations of Hedge:IQ

Hedge:IQ integrates an optimization algorithm that calculates the optimal hedging value with the company's cash pool information daily and in real-time. The optimization algorithm's tasks are:

- monitoring the development of the N.N. Cruises cash pool in real-time;
- calculating a daily hedging strategy based on the cash pool development and to indicate the value of the optimal hedging position;
- indicating which hedging tools should be used for the optimal hedging strategy; for example, a ZAR loan with or without a combination of derivatives.

Thereby, the optimization algorithm is expected to be resilient and to work consistently. It also is required to calculate the optimal strategy when the South Africa travel bookings, the ZAR revenues, or the currency exchange rate deviate heavily from former assumptions or data.

The optimization algorithm relieves N.N. Cruises from answering the questions that the company asks in order to manage its currency risk effectively. It calculates the trade off from the hedging costs and from the company's profit margin. How can the profit margin be preserved while the currency risk is being absorbed?

The optimal hedging rate permits the maximization of the profit margin, which is included in the exchange rate fluctuation just as much as the potential loss is. Even a small excess hedging or hedging shortfalls lead to the exact opposite. The profit potential is "cut off" at simultaneously increasing costs for the hedging, the costs that account for a definite loss, and therefore the narrowing of N.N. Cruises' margin.

Hedging at the best daily price: Deal:IQ

How can the optimal value of a ZAR loan be adjusted daily? That is where Deal:IQ (an application for the management of a margin based currency product) comes in. N.N. Cruises sets up a ZAR trading account at its house bank, which can be leveraged to an agreed upon ZAR amount. It will often occur that companies can exchange currencies without having to collateralize their account with their house bank. The factual proceedings depend on the business relationship of the bank and the company and on the achievable currency prices that can sometimes be more profitable with FX platforms, which means cheaper.

When Hedge:IQ, which can be integrated with Deal:IQ, discloses the optimal hedge rate at a given time during the trading day, Deal:IQ assumes the amount and the responsibility for the hedge execution. Deal:IQ is going to monitor the trading day and will then autonomously decide at what point in time (in the morning, afternoon, maybe not during a

scheduled event such as the press conference of the European Central Bank) which part of the total hedging value should be bought at the best possible price that occurs during the day. Benchmark is the average price of a day, the TWAP. By the end of the business day, Deal:IQ is going to have completed the acquisition. On the next business day, a new episode will begin with a new updated daily hedging strategy and a new task for Deal:IQ.

Customer benefit

- **High transparency.** Integrated Currency Risk Management, i.e. the algorithmic hedging of the currency exposure, is very transparent, because it predominantly uses the spot market for the hedging of currency risk.
- **Low costs.** Integrated Currency Risk Management is cheaper than buying financial instruments from banks.
- **High flexibility.** Integrated Currency Risk Management avoids the buying of derivatives because of their unfavorable expiration dates. Hence, it is much more flexible than buying derivatives. A company can cancel their algorithmic currency hedging on a daily basis without any drawback for the company.