Cost Analysis & Forecasting for Finances and Quality

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ABSTRACT

Analyzing and forecasting warranty expenses without the use of dedicated tools can be challenging. When data is scrutinized in such a way that it can be utilized on multiple levels – such as for financial and quality work – a company can maximize its use of limited resources. Routine tracking of performance against target and plan are a key starting point. This can help to determine where the most energy should be focused based on the level of analysis necessary for a particular product or subgroup. Ensuring that the output clearly conveys the desired take-away to those who are not intimately familiar with the details is critical to expanding understanding of warranty spend within an organization. Participants will learn the following:

- Importance of routine performance tracking
- Value of varied levels of analysis
- Method for performing cost analysis
- Application of results beyond warranty

INTRODUCTION / BACKGROUND

Understanding the cost and failure rate impact of warranty claims can be useful for financial planning. When done in the correct level of detail it can drive action to minimize the impact of warranty on the company and the customer. As part of a fully inclusive model, the results will be of even more benefit and are apt to be more accurate. Since every company has finite resources, it is beneficial to utilize analysis for multiple purposes whenever possible.

Many companies warranty forecasts are centered on a very rough estimate of what potential spend risks there are with no account for the magnitude of the actual issues. This can lead to repeated reserves of lump sum amounts with no visibility to what the next request might contain. This “rear view mirror” approach is often accepted until a breaking point is reached, potentially due to one too many large reserve accruals, economic down turn or a similar event. The experience at Volvo is no different.

Over the past five years, more emphasis has been placed on understanding the content of warranty expenses as people have realized the significant impact which it has on the bottom line. Improvements began with product line forecasting for products in current production. Products carry two to five year warranties so there was significant spend on older product, but a breakpoint was needed. They evolved further with the integration of quality issues and improvements, ensuring that warranty and quality organizations communicated a harmonized message.

The last significant change was presenting a clean view to management of the different significant warranty financial numbers, integrating everything into one package: provisions, supplier recovery, profit elimination, actual spend, forecasted spend, volumes, payment plans, etc. This also greatly aided in identifying which products were at risk of cost deviation much earlier in the life to the point of knowing a product is produced whether warranty funds are properly allocated.

Throughout the entire process, no investments were made in software beyond what the company had already purchased. A multitude of inputs can affect the final spend of a product and when that spend will occur. The goal of this analysis model is to account for the most critical of these factors while acknowledging not all nuances are addressed and likely cannot be. Calculations and follow up are managed in a complex system of Excel spreadsheets. Although there is a substantial time investment required, the results have proven quite useful and speak for themselves. Previous forecasts had accuracies as low as 72%. The 2011 forecasts were over 98% accurate. By way of example, forecasts for two-year average growth rates for Real GDP by the Congressional Budget Office showed an average of 2.8 points of change per year versus an actual average of 3.0, approximately 7% difference. Five year forecasts during the same period showed even more variation: nearly 13% error. [1]

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[1] Forecasts referenced were produced from 1992 through 2008. Additional data may be found in the United States Congress Congressional Budget Office’s Economic Forecasting Record: 2010 Update (Washington: GPO, 2010).

ANALYSIS MODEL

In looking at warranty expenses, there are several basic questions that need to be addressed: what (type of failure?), when (will it occur?), and how (many failures?; much will it cost?).

A good starting point for analysis is considering what failures will occur. This is done through stratification of warranty data to sort out different components/systems which are showing the largest impact – either in terms of cost or failure rates. Creating a Pareto of results outlines the starting point. When the group sizes fall below a certain threshold, they can be lumped together. This ensures everything is captured without creating excessive work versus the payback. Approximately 80% of the cost or failures (depending on the focus of the analysis) should be put into specific categories before summing the remainder.

This method of calculation offers diversity in its level of complexity and scalability. For products which show uniformity in design and performance, it may be sufficient to be less detailed in the calculation. At the most basic level, a simulation can be run on the entire population, counting each failure equally regardless of impact to the user or cost of the repair. This yields a high level overview of the product, but does not lend itself to additional use. It is better to expand the model so the results can be applied on a broader scope. Grouping by major categories – for instance, by failure mode or subsystem – can provide generalized forecasts that may satisfy the needs from a financial standpoint and can begin to drive focused quality improvements.

Segregating different populations and grouping distinctive failures adds increasing levels of complexity and time, but can yield valuable outputs. This can mean grouping by different model types, product applications and known failure modes, among others. Care in defining the categories of failure up front will yield great benefits as the calculations proceed forward. This may require some manual sorting of claims (for instance to identify issues that are known to be coded incorrectly).Knowing specifically when failures can be expected to occur, what type of failures these will be, expense to the company and impact to the user can be used to guide the work of design teams and focus quality improvements in the areas that will yield the greatest benefit to the company and the customer. It will also provide key information on the impact of warranty to the company's bottom line and when the highest level of expenses will occur. Thus, warranty can be used to drive the business instead of being a pricey afterthought.

Now that the issues have been defined, the next concern is quantifying the magnitude of the problem. Utilizing Weibull analysis[2] in a software package to perform the reliability calculations reduces the manpower and high level of expertise required. Although analysis can be done long-hand, the manpower involved can be cost prohibitive. Either way, this analysis will identify the population most likely to experience failure.

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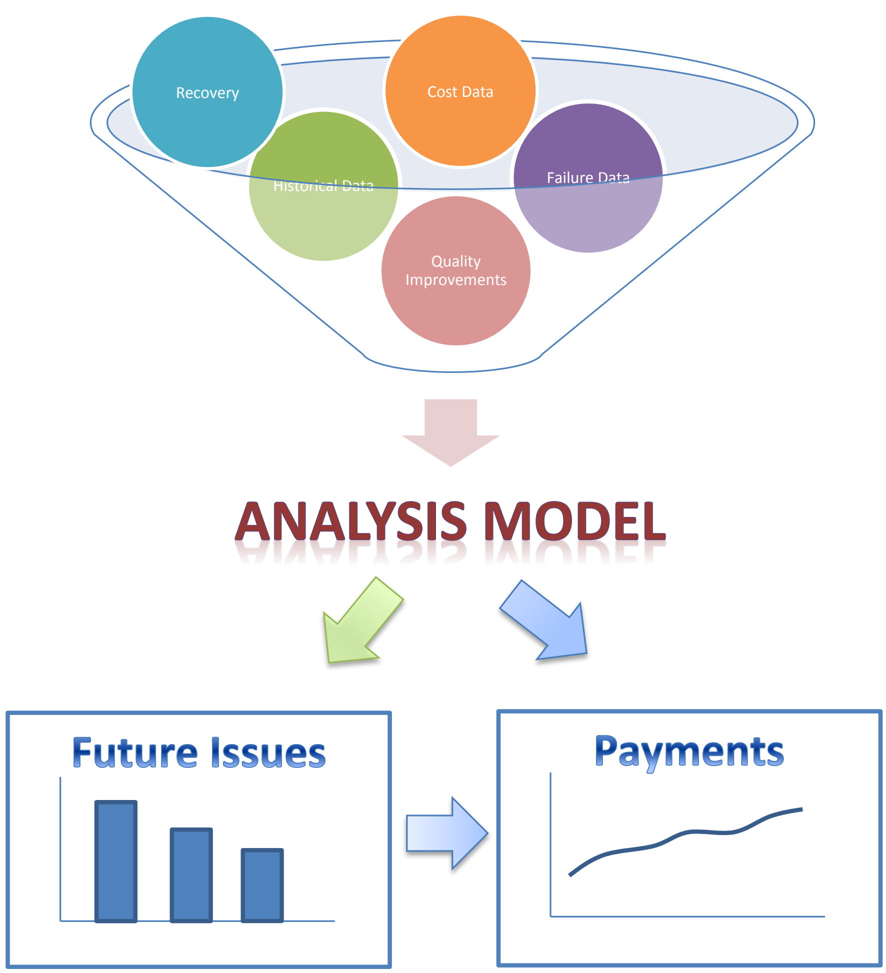
[2] Although "Weibull analysis" is the term used in this paper, the reference applies to any reliability forecasting model including gamma, log, etc.

Taking this a step further involves an additional input: known quality changes (positive or negative) which adjust the historical failure rates for present production. Accounting for such quality changes can have a significant impact on future reserves. Conservative improvement estimates should be used until root cause is defined and understood. While there is a need to account for improvement, this more conservative approach helps prevent inaccurate reserves. Historical fix rates can be utilized for this process.

When all the inputs are combined, they create a total prediction for quality. A roadmap of failures and overall quality of the product can be created based on this information. This data can also assist in evaluating past reserve levels and forecasting expenses related to future populations.

Now that the expected quantity of failures is established, the addition of some basic financial information yields a cost prediction. Incorporating potential recovery helps to further refine the calculation. Although not influential from the quality perspective, the financial impact may be quite significant. As with other inputs, the more detail put into these values, the more useful the results.



For cost accrual, the subject of payment timing is considered last even though management often sees it as most important since it impacts the bottom line directly. In view of the fact that many different issues can impact when the payments occur, my preference is to remove these factors and consider that portion last. Many things – from the economy to dealer behavior to warranty system rules – can impact the exact timing of payments.

Creating historical payment curves can give a general idea of when spend will occur. This is done by taking products that are completed through their warranty life cycle (not just units, but entire populations) and dividing spend in a given year by the total. This calculation approximates when spend will occur if the predicted product follows the exact same trend as the reference population.

A problem arises, however, when there is deviation. Perhaps for less complex products, there will be little variation. In the trucking industry, experience shows that similar populations can have variation from build month to build month and new or unexpected issues (especially at high mileages) can greatly alter the shape of the payment curve. Chart A below demonstrates the impact of payment plans that differ from the average. While some populations may match the average (such as population 1), others can fall above or below by significant amounts (e.g. – populations 2 and 3) even if the total spend is the same. Focusing too much energy on the payment plan can create a false illusion that there is a problem or that everything is fine when this may not be the case.

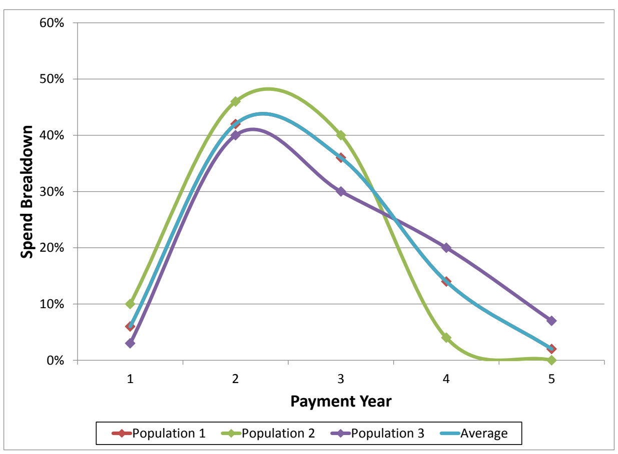


Chart A

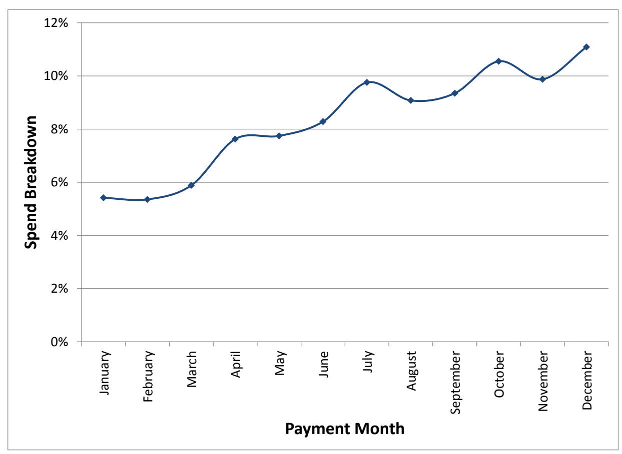


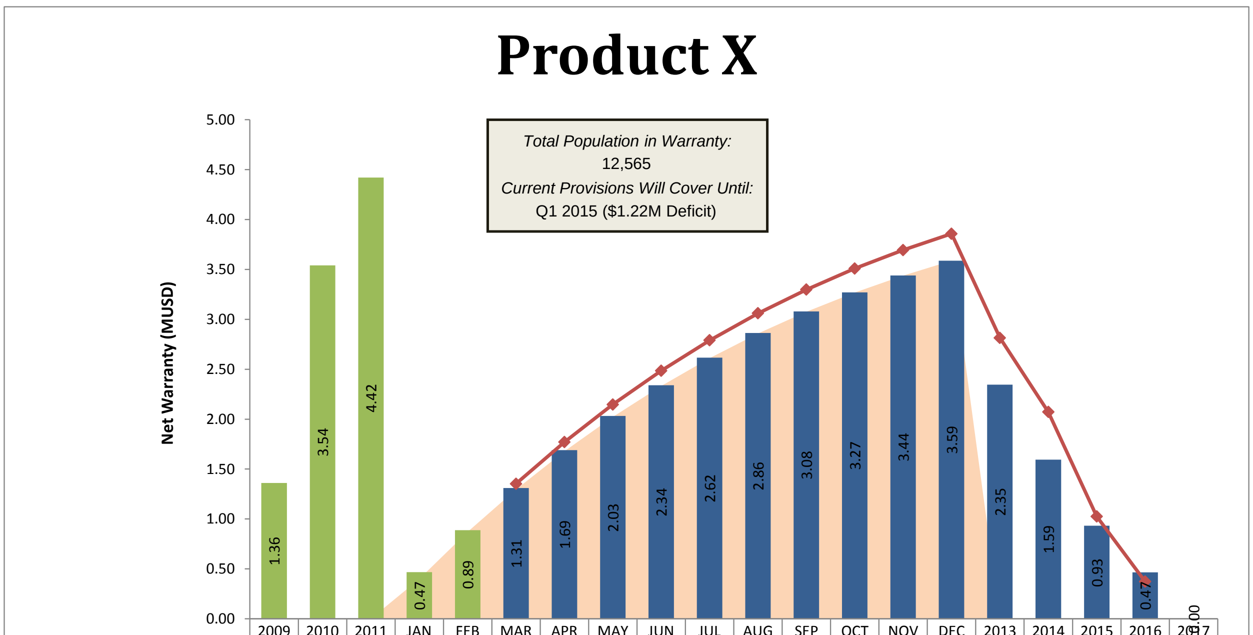
Chart B

Payment plans can also be broken down by month (see chart B). The specifics of warranty application can change the time periods to be shown. If there is known variation which can be accounted for each period, this is the place to take such factors into account. Combining these payment plans with the information previously discussed can yield solid forecasts. Emphasis on the magnitude of issues helps to take some of the variability out of the overall results.

APPLICATION

The archetype that has been outlined is especially useful because it is a fully integrated method. All key aspects affecting warranty are tied together in one place. This helps ensure everything is accounted for in calculations. Adding a visual element gives ease of understanding at all levels regarding where a product stands. It also helps give an early indicator when something is off track and should be closely monitored or re-reviewed.

The chart below demonstrates all major inputs combined into one source without becoming too cluttered. It incorporates actual payments, targets, forecasts based on what has previously been provisioned (eg – what spend must look like to not over- or under-spend), forecasted risk, population in warranty, and potential cost surplus or shortfall and when it will occur. In this example, a risk of overspend has been identified, but current reserves will cover until early 2015.



	2009	2010	2011	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2013	2014	2015	2016	2017
Target (2012 YTD)				0.40	0.87	1.30	1.68	2.02	2.33	2.61	2.86	3.08	3.27	3.44	3.59					
Payments (Actual YTD)	1.36	3.54	4.42	0.47	0.89															
Forecast (Provisions)						1.31	1.69	2.03	2.34	2.62	2.86	3.08	3.27	3.44	3.59	2.35	1.59	0.93	0.47	0.00
Forecast (Warranty Risk)						1.35	1.77	2.15	2.48	2.79	3.06	3.30	3.51	3.69	3.86	2.81	2.07	1.03	0.37	

Current year values are cumulative. All other values isolated.

Reviews of different product groupings should be conducted regularly. Tracking the spend data per the above method on a monthly basis ensures all products are being monitored and helps minimize surprises. Products following the forecast without deviation and with no known quality bumps (plus or minus) may only require a review on an annual basis. On the other hand, products which show significant deviation for at least a quarter should be re-analyzed.

All assumptions should be clearly documented throughout the analysis. In doing so, future confusion about what the forecaster had in mind when creating the estimate can be minimized. Documentation may also help to increase accuracy going forward through analysis of the inputs when the model fails to predict the correct result. If there is deviation from the forecast, revisiting the assumptions can give clear explanation why results are not tracking as anticipated.

LESSONS LEARNED

The most challenging obstacle throughout this process has been conveying the immense amount of details that go into the calculation in a simple manner. Often those making a decision on what reserve levels are acceptable do not understand the nuances of the calculations. The fully integrated model has received the most support and buy-in, but education still remains the biggest concern.

Clear documentation of process steps and assumptions adds value and has been a lesson learned the hard way. While early forecasts included some documentation, it was not thorough enough. Making notes of where data comes from is important, but also including the logic is even more beneficial. The model can be fine-tuned using this information as it applies to specific products or industries.

There is also a certain factor that experience and intuition play in the results of these calculations. While many things can be boiled down to black and white calculations, others require knowledge and experience to know when something is not as would be expected. Familiarity with the calculations and data helps to develop an instinct for when additional investigation is needed. It is not a guarantee given experience that a person will acquire this instinct, but it is almost certain that it will not be developed without experience.

CONCLUSION / SUMMARY

Overall, the experience with this model has been incredibly favorable. Accuracy levels in excess of 98% are difficult to improve upon regardless of calculation method. Such results have confirmed the work being performed is correct and useful. There has been more confidence expressed by management regarding the results than ever before. Integration of all key warranty cost and failure inputs within one system has been critical to the success of this model. Warranty is not an isolated event and treating it as such can result in financial inaccuracy. With attention and time, warranty data can become a tool used to drive successful business practices.