1. Introduction

As the name implies, a benefit or feasibility study assesses the value a project will bring. With a typical payback time of less than six months, Advanced Process Control projects very quickly generate sufficient benefits to customers. There are, however, more reasons to carry out a carefully conducted benefit study than a detailed justification of costs. Benefit studies may be used as basis for implementation and benefit guarantees, but are also the start of demonstrating to the potential customer that an APC controller may change the way the plant is operated. It is therefore very important to ensure that all stake holders, be they operators, plant engineers, (advanced) process control engineers, and (plant) managers, are exposed to the new technology, and by doing so, that the chance of a successful APC project is maximized. Implementing an APC project requires good teamwork between vendor and customer, and the benefit study is often the first opportunity for the future team members to work together. This paper describes the best-practices IPCOS follows when carrying out APC benefit studies, with examples from ammonia and methanol plant studies.

The benefit study carried out by IPCOS on an ammonia or methanol plant is based on a site visit by IPCOS engineers lasting several days. In preparation for a site visit, the customer is asked to fill out a questionnaire with questions about plant licensor (for example, Haldor Topsøe, Uhde), the equipment used (i.e. ATR, coldbox, CO2 absorption), and the state of instrumentation and DCS. The customer is also asked to indicate the typical operating strategy and constraints. Supporting documents such as operator screen printouts, PFD’s and P&ID’s, and tag lists are also requested. With this basis, the IPCOS engineers are fully prepared to discuss plant operations in detail from the moment they are onsite.

2. Methodology

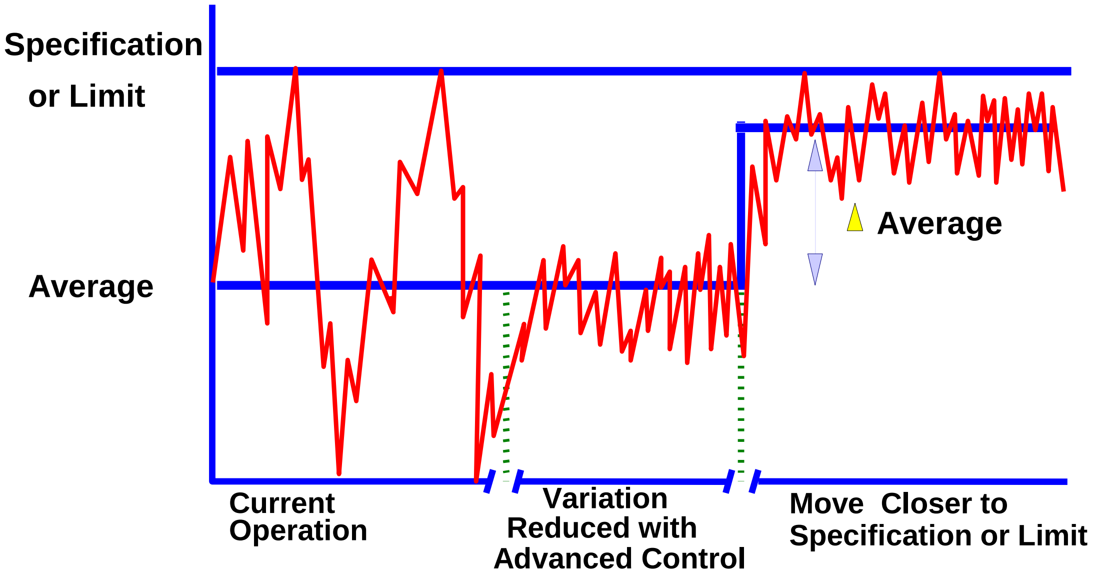
The site visit consists of a series of interviews. Probably the most significant interviews are in the control room, where operators are asked to explain his or her normal activities during their shifts. The method followed is to ask the operator to describe the process from battery limits to final product, allowing the IPCOS engineers to quiz the operator at each stage about operating strategy, constraints and limitations, and potential optimization areas. Operators are asked which indications they look at, which targets they aim for, but also for their views on how their control of the plant and optimization of production could be improved. The existence and use of advanced regulatory controls, e.g. duty controller, are identified. IPCOS always aims at repeating the same questions to various operators, as everyone has their own valuable input and insights. Seemingly small details such as familiarity with the DCS screens and prior experience in the specific process are critical to asking the right questions in this phase!

Plant/production engineers are interviewed for their broader views. This is about strategy (higher throughput at all costs versus maximum plant efficiency versus better control of critical constraints), scope (include utilities? Product quality?) and about plant constraints and design values. For example, plant engineers will be quizzed about optimal S/C, A/G, and H/N ratios for the specific catalyst employed, as well as the seasonal variations in process control that operators typically lose sight of in their day-to-day operation of the plant. Plant engineers are also often involved in discussions about the best strategy to take for optimization.

It is not only technical information that is required for an accurate benefit assessment. Plant managers are interviewed for their views on strategy and long-term goals as well: if 1% extra ammonia can be produced through use of an APC controller, can this ammonia be sold or processed downstream? How about load balancing between various plants? Are there e.g. environmental /emission constraints that threaten the plant exploitation?

3. Data

The final series of 'interviews' is with data: data is king! For accurate benefit calculations, high quality (that is, not overly compressed) historical process and LIMS data is essential. IPCOS uses 1 year of data, usually sampled at 1 hour, for quantitatively demonstrating benefits. Keeping in mind that an automatic APC controller can usually maintain constraints more accurately than an operator, even areas that are said not to be a limitation are verified. A common example is the excess combustion air for the primary reformer, in case there is no automatic combustion controller: although operators will typically do their best to minimize this value, it depends strongly on how much time is available for an operator to do so how well he achieves this. Individual savings may not be very impressive, but as part of an APC controller, the drops in the bucket can fill a sizable bucket very quickly! Frequently, the optimal operating point is a matter of identifying the most optimal operating points for each constraint or unit equipment, and then driving the plant to the set of constraints that generates the highest benefit.



For ammonia plants, the most common areas for which opportunities are calculated are listed below. This is not to say that an APC controller will include all these areas: Keep It Simple is very important if the controller is to receive widespread support within the operations team!

- Feed gas compression
- Hydrogen for HDS control
- Primary reformer outlet temperature
- Primary reformer excess oxygen and draft control

- Heat recovery in the convection section of the reformer
- HTS and LTS temperatures
- CO_2 recovery section, amine regeneration
- Syngas loop: pressure and purge optimization
- Steam to Carbon, Air to Gas, and Hydrogen to Nitrogen ratios
- Steam balance

At the conclusion of the study, a report is submitted to the customer. The level of detail may depend on the price paid for the study, but the report is always a good basis on which both commercial and technical viability can be judged. The most detailed report will give an accurate quantification in which process area benefits can be generated, and in which manner. The quality of the study should build the confidence of the customer in IPCOS as APC implementer and the confidence to push the plant to new levels of productivity and/or efficiency. All the key stakeholders will have been exposed to IPCOS and the methods of APC control, already in this early stage building a team for successful APC projects.

4. Conclusion

Unfortunately, not all benefit studies result in the awarding to IPCOS of an APC project – some benefit studies (although rarely for methanol or ammonia) may indicate that the customer must first address automation, instrumentation, or equipment issues before APC can be implemented. But when an APC projects has been implemented, the plant optimized to the full potential without hardware modifications, and a post-audit is carried out, it is always interesting to see how the end result compares to the predicted results. Ideally, the actual benefits should be generated in those areas identified during the study, and the total benefits should exceed the expected benefits by no more than a comfortable margin. As case in point, the following table compares the relative contribution of each section to benefits for a methanol plant.

Table 1. A comparison of the contribution of optimization by APC of specific plant areas for a methanol plant, between the benefits study and the realized results through a complete APC project. Both columns add up to 100%, but the total achieved benefits exceeded the estimated benefits by 50%.

Process Unit	% estimated by Study	How ?	% of realized results
Reformer Section	10%	Fuel Gas Saving	35%
Synthesis Section	33%	Hydrogen saving/synloop conversion	36%
Saturator section	8%	Steam saving in saturator	0%
Topping Column	2%	Steam Saving in Topping Column	3%
Refining Column	21%	Steam Saving in Refining Column	22%

Recovery Column	2%	Steam Saving in Recovery Column	4%
Distillation Section	13%	Quality Control in Distillation Section	Included in column steam savings
Steam Header	11%	Steam saving from venting	N.Q.