Background

The City of Grand Rapids Michigan, Environmental Services Department works to improve the quality of life for its citizens. The ESD uses sustainable practices to protect the environment, and public health and welfare. They service 272,000 people in 11 customer communities, operate 56 lift stations and the Water Resource Recovery Facility, a Utility of the Future Today designated facility. The facility collects and treats an average of 40 million gallons of wastewater a day. ESD also oversees storm-water management; green infrastructure; energy, lighting, and communication; and air quality in the City.

In October of 2005, the EPA published the Cross-Media Electronic Reporting Rule (CROMERR). The rule provides the legal framework for electronic reporting under Title 40 of the Code of Federal Regulations to EPA and state, tribal and local governments that are authorized to administer federal programs. The regulation authorizes and facilitates electronic reporting for environmental programs while maintaining the level of corporate and individual responsibility and accountability that exists for paper submissions.

In Grand Rapids there are 84 permitted industrial users that have the opportunity to use CROMERR. CROMERR requirements for electronic reporting are comprehensive and include:

- Timeliness of data generation,
- Integrity of the electronic document,
- Submission knowingly with intent and not by accident,
- Opportunity to review and repudiate copy of record,
- Acknowledgement of receipt, and
- Determining the identity of the individual uniquely entitled to use a signature device.

CROMERR does not impose technical or business process approaches to the collection of information. Rather, it specifically allows for the evolution of technology and business process approaches and welcomes creation of new and novel ways of meeting CROMERR requirements.

ESD selected improvement of CROMERR business processes for study in this UAIM case study. Many opportunities exist for substantial reductions in the workload required by both industry and ESD to meet CROMERR requirements. These opportunities include:

- Real-time Feedback on Compliance Samples reducing potential violations
- Automated Data Transfer
- Default Form Configuration
- Automated Report Reminders

Case Study Description

This project applied the UAIM methodology to identify opportunities, develop As-Is and To-Be models, perform analysis of these models with stakeholders to ensure that improvements were

realized, and implementation as part of a change management program. An innovative aspect of this case study was the use of business process simulation, both to confirm that the models were accurate and to obtain quantitative cost and cycle-time information that demonstrated the improvements.

Following the UAIM methodology, the project was completed in the following steps;

1. **Define**. Complete internal project setup and management procedures, choose project participants and reviewers or stakeholders, and identify and document background materials on the process to improve.
2. **Measure**. Plan and conduct As-Is workshop, create the As-Is BPMN model and model library, and document the As-Is process in results of analysis and summary reports.
3. **Analyze**. Plan and conduct post-workshop meeting, perform analysis to identify improvements, create the initial To-Be BPMN model, and document the To-Be process, results of analysis and summary reports.
4. **Improve**. Refine/update the To-Be BPMN model, plan and conduct review & validation meeting, and document the improved To-Be process, results of analysis and summary reports.
5. **Execute**. Develop a change management plan, implement technology enhancements, and conduct stakeholder engagement meetings.

A sixth step, **Sustain**, is an on-going process that includes planning and conducting review meetings, preparing feedback on process documentation, and providing coaching assistance where needed – all to ensure that changes are maintained and continue to improve.

In the Define step ESD established the project stakeholders and procedures to follow and selected the CROMERR process for analysis. Considerable work had already been done after publication of CROMERR and examination of existing processes suggested that improvements could be achieved through automation of the process used to collect and submit data and reports through Linko Exchange.

The Measure step consisted of creating an As-Is model using the Business Process Model and Notation (BPMN) standard and documenting this process (Figure 1). Formulating the model required learning BPMN and understanding patterns that accurately represented the real process. The modeling standard is comprehensive and forces attention on process details that would not be correctly represented in written documents or process depiction tools such as Visio or PowerPoint. Finding a proper balance of time between learning correct modeling technique and driving progress towards process change was an important consideration in the project. Simulation tools (described below) helped to accelerate learning and resulted in improved models by removing bottlenecks, addressing rework and better representation of the actual processes.

With the As-Is model complete, the Analyze methods resulted in candidate process changes in an To-Be BPMN model (Figure 3). In both the As-Is and To-Be models color-coding was used to group the process tasks; purple for sampling tasks, yellow for handling violations, and blue for reporting. Comparing the two models (Figure 1and Figure 3) a number of activities are the same, with changes to routing of information to reduce cycle-times within the process, for sampling and violation-handling processes. The number of manual reporting processes are reduced in the To-Be model, the result of benefits derived from an automated report management system. The models helped to convey the changes to others, communicate specifics and through this process highlight the most important changes. Meetings with project stakeholders confirmed the validity of the To-Be model and showed that additional simplifications were not beneficial or would be costly to implement.
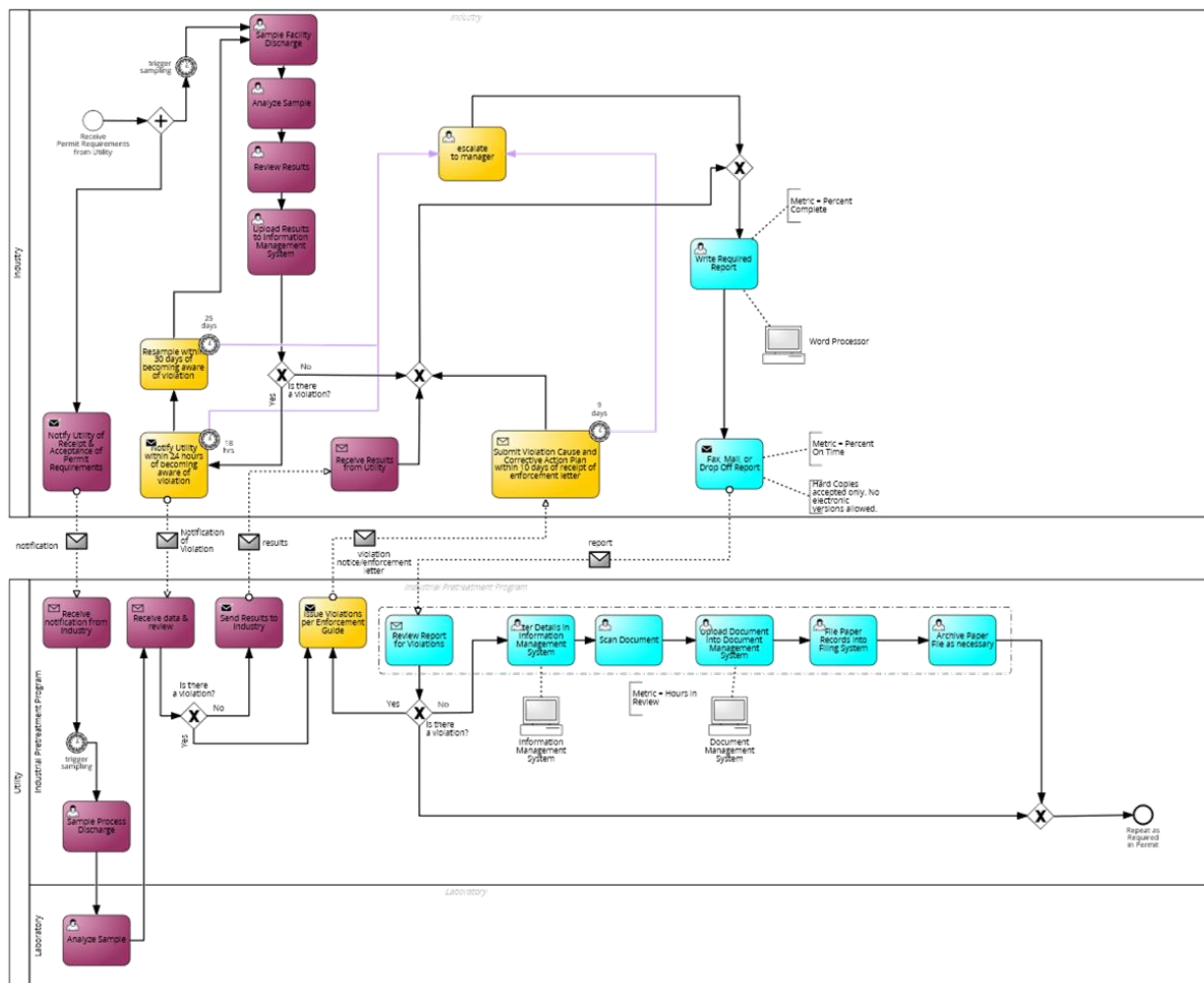
Figure 1. CROMERR business process As-Is model.

The Improve step focused on using business process simulation to check for process configuration changes, eliminate bottlenecks, and quantify the costs and processing time reductions that might be realized in the To-Be process. Examples of process configuration and bottleneck analyses are shown in Figure 2. This work required additional meetings to determine the frequency of different events that start the processes, costs for activities, and probabilities that reflect how different decision options occur. This enables the project team to watch how work actually flowed, compare adjustments in resource cost and availability and collect process cost and cycle-time data (see below for a summary).

Initial As-Is models separated a review of industry reports for violations, which were immediately flagged for processing related to the violation (Figure 2 (a)). This was followed by a separate review to check for accuracy and completeness; however, it was clear that these review steps could be combined to reduce the total process cycle-time. Collapsing processes into single, more efficient processes is a benefit derived from applying technology and encouraging cross-training of existing resources.

Bottleneck analysis is shown in Figure 2 (b). Shown at the right of each activity is a bar chart showing processes activities completed and, on the left (for some activities) dots that represent work that is waiting to begin. Activities with many dots indicate a bottleneck.
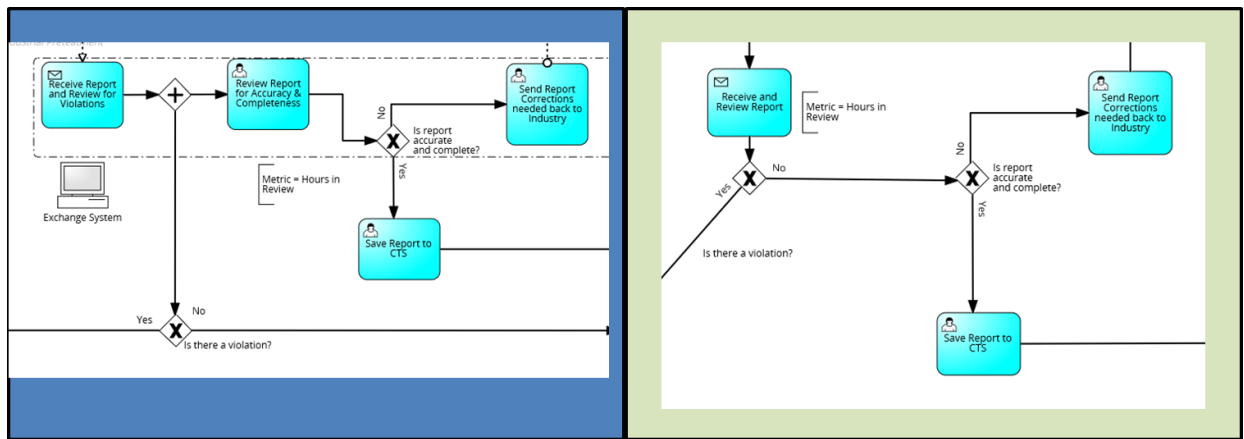
Before Simulation   After Simulation

(a) Process Configuration Changes
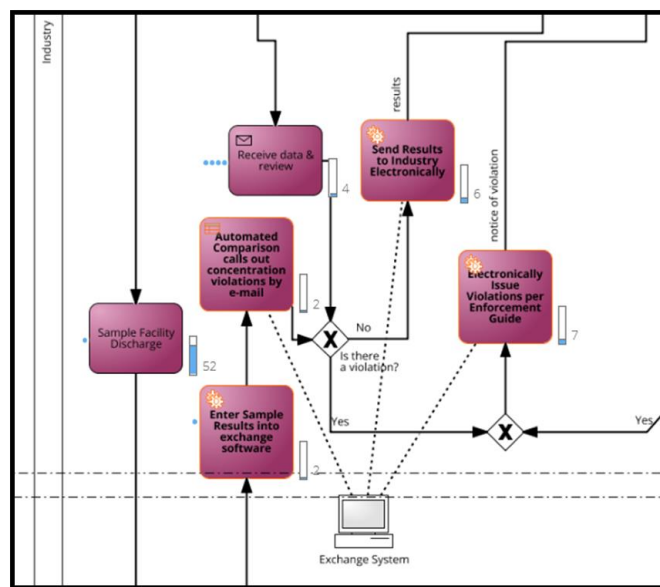
(b) Checking for bottlenecks

Figure 2. Using simulation to (a) find process workflow improvements and (b) find bottlenecks.

The bottleneck analysis showed the importance of the sampling activities and that additional resources may be required to support review of these data. While additional resources can help, it's also possible that allocation or personnel or automated systems creates bottlenecks elsewhere in the process. The benefit of creating a simulation model is that these tradeoffs can be examined quantitatively. The resulting As-Is process model applied these methods to understand, to communicate, and to document important process features.

Simulations were also used to compare different configurations of the As-Is and To-Be models (Figure 4). In a typical year 53 cases (~1 per week) would be examined, and 2 full-time equivalents are available for supporting the CROMERR process. Analysis using simulation showed that all cases could be completed but that the costs and time-to-complete were dramatically different. A 30% reduction in cost could be achieved by reducing the number of hours required by ESD resources from 515 hours to 93 hours. For the industries reporting similar reductions could be achieved in the To-Be model, a welcome benefit that encourages improved compliance reporting.
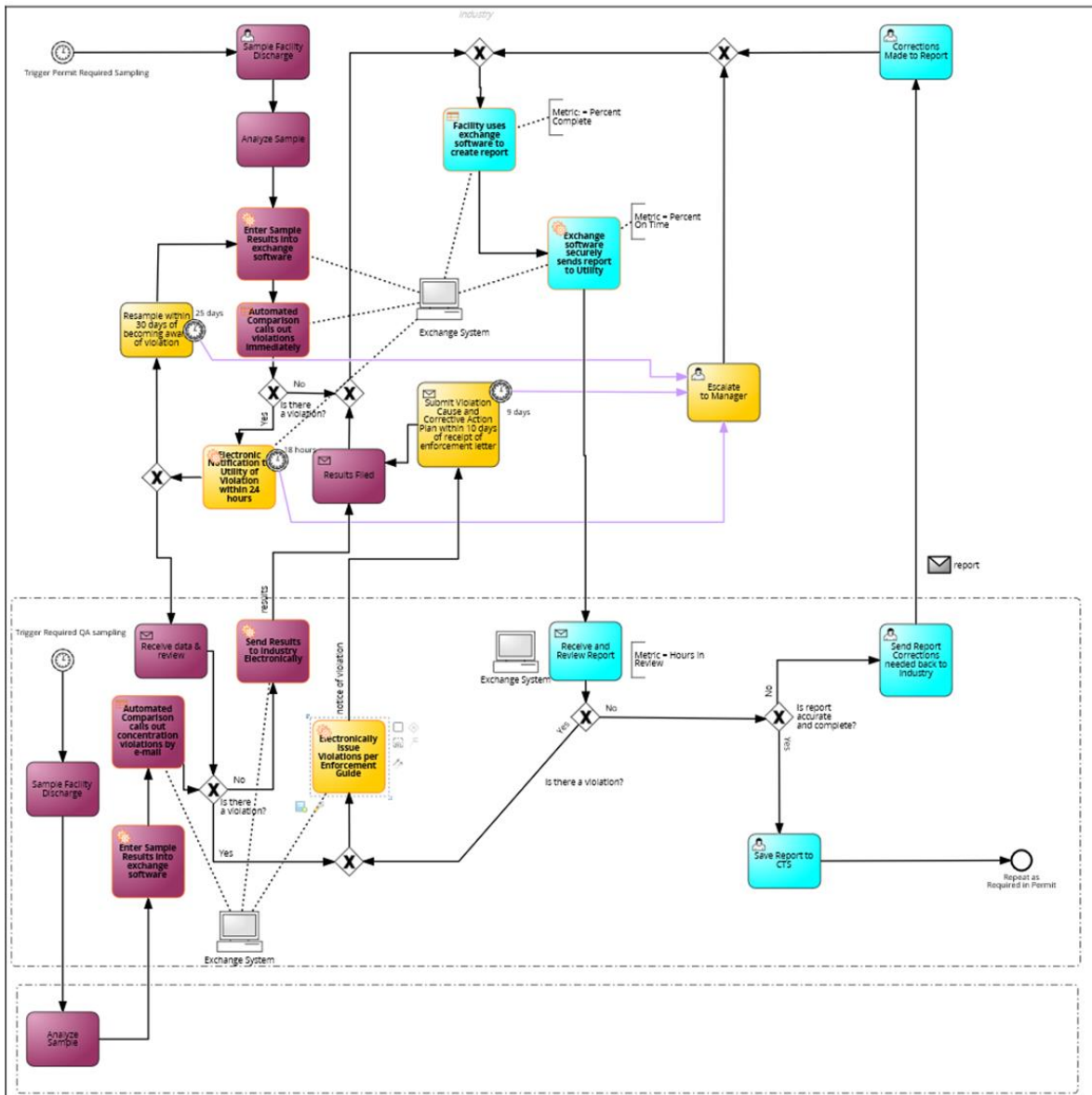
Figure 3. CROMERR To-Be model.

Metrics
53 cases over 365 days, 2 FTE

As-Is Model

- Cost: $102,410
- Percent Complete: 100%
- Utility Hours of Review: ~515 hours
- Industry Hours for reporting: ~300 hours

To-Be Model

- Cost: $70,143
- Percent Complete: 100%
- Utility Hours of Review: ~93 hours
- Industry Hours for reporting: ~ 10 hours

Figure 4. Comparison of As-Is and To-Be models with simulation.

Successful Strategies

Overall, the BPMN process helped define the process in tangible steps. Visualizing the connections and the interrelation between each of the tasks was helpful to understand basic modeling, but the BPMN was also a valuable tool used in communication with stakeholders, both internal and external, and in general, it was much easier for anyone to understand over written statements. Spending the time to learn how to properly the business process was well worth the time invested.

The other value of BPMN was the addition of the BPMN simulation. Simulation added many benefits to the model including helping with the accuracy of the model, streamlining the model, and quantifying the benefits. First, the accuracy of the model increase as simulation shows the work process flows, the modeler can measure it against how the model was intended to flow.

Simulation also allows focused efforts in streamlining the process. With the simulation results, bottlenecks and backlogs become very evident. As you change the process or associated resources, you can see how these bottlenecks move through your process or are eliminated. As a manager, this process can keep you focused on ensuring you have enough resources providing for your limiting constraints.

Lastly, one of the greatest benefits of simulation was how it quantifies the costs and resources required to run the process. One of the most difficult parts of change is getting buy-in from stakeholders, both internal and external. When you can show the simulated process, how it works, and what the benefits will be, it becomes easier to understand and easier for people to invest in. In the City of Grand Rapids' CROMERR change process, the simulated benefits showed stakeholders that investing staff time to learn the computer program upfront will yield long-term savings. Long term revenue savings is an easy sell for many industrial users.

Lessons Learned & Ongoing Challenges

The CROMERR process improvement study demonstrated how business process improvement methods and tools defined by the UAIM can be applied to complete an improvement efficiently. The 6-step process structures and guides the effort by enabling better communication with stakeholders, encouraging work that is focused on real improvements, and driving towards the results that ESD needs to reach efficiency and sustainability goals. Formal BPMN modeling tools, which require investment in understanding, are an improvement over less formal, qualitative methods that can miss important details that can be both costly and beneficial. An innovative business process simulation approach gave the team a better understanding of work flow, and quantitative analysis generated useful data that demonstrated benefits.