White Paper

Understanding Production Efficiency in High-Volume Card Issuance Operations

ENTRUST

SECURING A WORLD IN MOTION

Table of Contents

Introduction

This white paper provides an overview of measurement and analysis for manufacturing efficiency in high-volume card issuance operations.

The information is provided in three sections:

- Calculating Speed and Efficiency
- Evaluating Efficiency for Varying Average Job Sizes
- Using Data Collection and Analysis for Evaluating Efficiency

The Overall Equipment Effectiveness (OEE) framework and the Theoretical Efficiency equation were written in reference to our client's card issuance operations utilizing the Adaptive Issuance™ Production Analytics Solution. The framework, measurements, and analysis reviewed in this white paper are suitable for measuring and understanding system efficiency and operational performance with any high-volume card issuance equipment that provides timestamped audit information.

Calculating Speed and Efficiency

Estimating the production capacity of card issuance systems requires an understanding of the maximum theoretical speed of the system, and the constraints that can limit the maximum practical output. These constraints, which provide actual output that is less than the theoretical maximum speed, include:

- System configuration
- Job size and setup time
- System service
- Production process

If the magnitude of each constraint can be accurately estimated or calculated, the actual output of the system can be accurately predicted.

To calculate speed and efficiency, we suggest OEE, which is a framework for measurement. The goal of the OEE approach is to give an understanding of the primary areas of productivity losses. It is a way to easily visualize the losses and dictate actions to remediate the situation. OEE is the result of these three production indicators: availability, performance, and quality. Each one gives an understanding of the production environment, focusing on losses.

Availability is the percentage of planned production time that the operation is available to operate. A perfect availability score would indicate that machines are always running.

$$\text{Availability \%} = \frac{\text{Run time}}{\text{Planned production time}}$$

Run time	The total time when machines are used for production in a running state (excluding idle and pause).
Planned production time	The total calendar time for the measurement period minus planned downtime such as maintenance tasks, holidays, and breaks in each shift.

Performance is the actual total production output compared to theoretical perfect production output, which is calculated using the machine's maximum cycle speed. A perfect performance score would mean machines are always running at maximum speed when active.

$$\text{Performance \%} = \frac{\text{Total production}}{\text{Maximum machine throughput x running time}}$$

Total production	The total number of cards processed, which includes both good and rejected cards.
Maximum machine throughput	The maximum machine speed in cards per hour.*

*The maximum machine throughput could be reduced based on the modules utilized.

The maximum throughput does not include track fill time during machine initialization. The maximum throughput for each type of machine is the maximum capability of the machine. The actual throughput of a production run is determined by many factors such as 1) the configuration of the machine, 2) production run job size, and 3) required personalization tasks.

Quality is the number of good units produced as a percentage of the total units started. A perfect quality score would indicate that all products are good, and no rejects were produced.

$$\text{Quality \%} = \frac{\text{Good Production}}{\text{Total Production}}$$

Total production = good production + rejected production

OEE helps you see and measure a problem so you can fix it and provides a standardized method of benchmarking progress. A perfect OEE would indicate the equipment is always running, running at maximum speed, and only producing perfect products without rejects.

Overall Equipment Effectiveness
(OEE)% = Availability (A)% **x** Performance (P)% **x** Quality (Q)%

Evaluating Efficiency for Varying Average Job Sizes

The factors that tend to limit system output are referred to as "output constraints." They cause the actual output to remain lower than the theoretical maximum speed. These output constraints include system configuration, job size and setup time, system service, and the production process. If the magnitude of each constraint can be accurately estimated or calculated, the actual output of the system can be predicted.

Among the most significant factors in determining system output are average job size and setup time. Before each job begins, the operator must load production data and, in most cases, load raw materials for producing the cards. Once the job has been started the system moves the first card through each system operation before the first completed card is produced. These two intervals, referred to as "setup time" and "track fill time," work to reduce the efficiency of the system since nothing is "produced" until the first card appears, completely personalized, at the end of the system.

Given the degree to which average job size impacts maximum theoretical throughput, developing a methodology for measuring and rating system efficiency offers a significant challenge. Small job processing is common in financial card production and is inherently less efficient due to the setup and track fill requirements. Other output constraints limit efficiency as well. The solution to this problem lies in using a measurement that has been "corrected" or normalized for the impact of average job size variation.

Calculating Theoretical Efficiency

The efficiency of a Datacard® MX Series System or similar type of production system can be shown to be a function of job size, maximum rated throughput, track fill time, and job select time. This relationship can be expressed through the following set of calculations:

Theoretical Efficiency =
f{Job Size, Maximum rated throughput, Track fill time, Job select time}

Job Run Time = (Job size) / (Maximum rated throughput)

Total Job Time = (Track fill time) + (Job select time) + (Job run time)

Effective Speed = (Job size) / (Total job time)

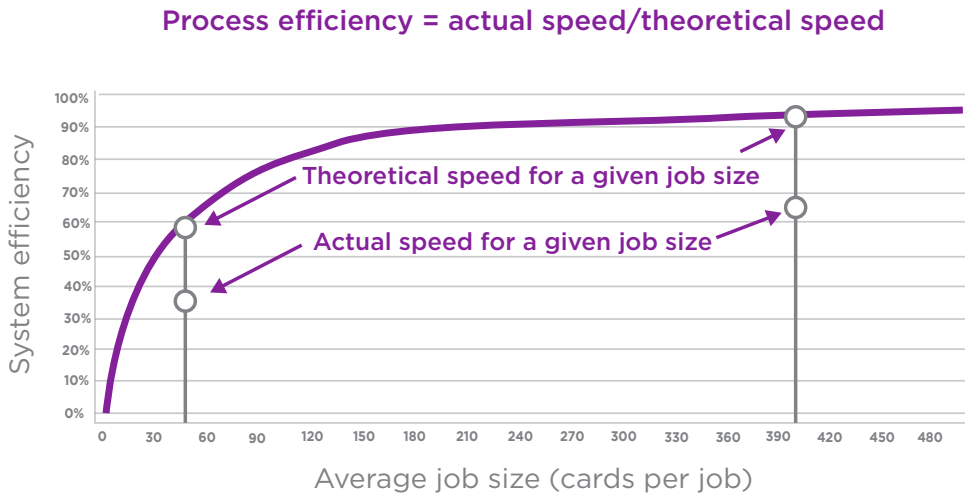
Theoretical Efficiency = (Effective speed) / (Maximum rated throughput)

So:

Theoretical Efficiency = (Job size/(Track fill time + Job select time + (Job size/Maximum rated speed)))/Maximum rated speed

The graph below and equations above are used for estimating system efficiency based on job size and can be used for a variety of purposes, including capacity planning and scheduling, and to refine the efficiency measurement methodology used in card personalization. A summary of the methodology can be seen below in Figure 1.

Figure 1 - Normalizing Efficiency for Job Size Variation



Although the job on the left is producing fewer cards at a lower efficiency than the job on the right, which is producing more cards, the process on the left is actually more efficient. (Smaller difference between actual speed and theoretical speed.)

By measuring the average job size for any system during a given time, and using a reasonable assumption for average track fill time and average setup time, the production manager is able to use the system efficiency vs. job size calculation to establish the maximum theoretical throughput for that system under a given job size constraint.

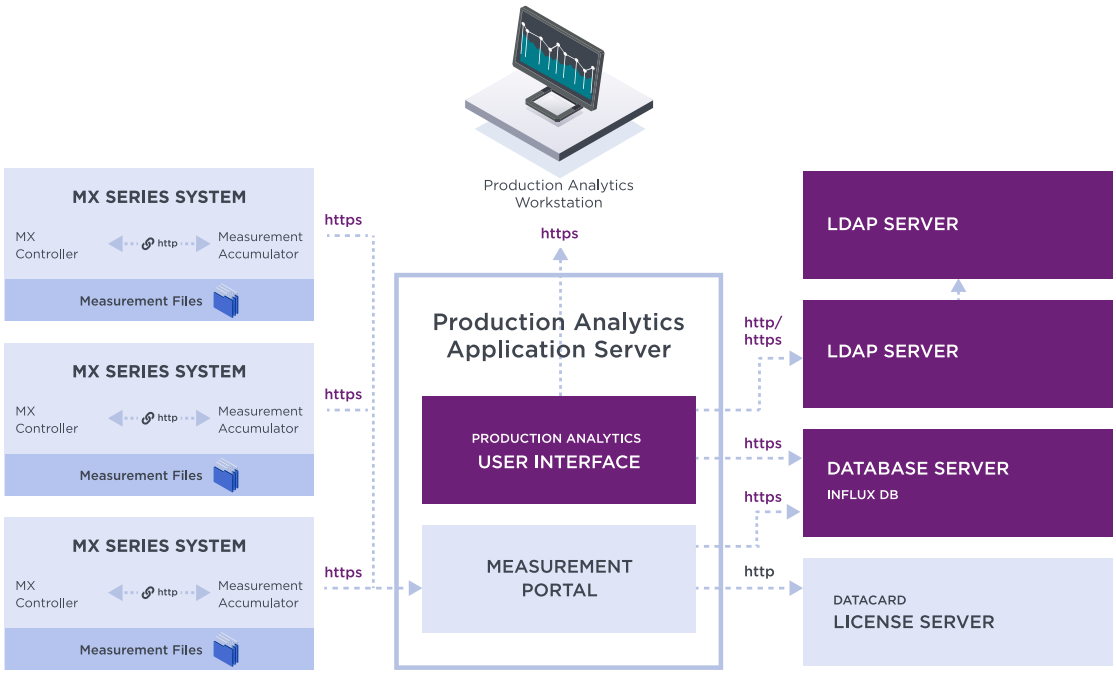
Using Data Collection and Analysis for Evaluating Efficiency

The information required to calculate system speed, average job size, and system efficiency can be obtained from the system's data collection. In the case of the Datacard® MX Series System, our Production Analytics Solution data collection tools can be configured to provide the following for a moment in time or over a period of time.

The complexity of data collection and performance measurement is a complex card production operation. Yet it is essential to do so in order to keep processes under control and to minimize cost. Entrust can help solve that problem with the Production Analytics Solution, which collects the hard-to-get data and organizes and displays it in a way that gives insight to production managers.

The goal of the OEE approach is to give an understanding of the primary areas of productivity losses. It is a way to easily visualize the losses and dictate actions to put in place to remediate the situation.

Figure 2 – Adaptive Issuance™ Production Analytics Solution - Components Diagram



The Entrust analysis model shown in Figure 2 starts with our team of engineers meeting with the client. During this initial meeting we lead a discussion on the data our tools are designed to collect and how that data is collected. It is up to the client to guide us in determining which systems will be included in the analysis. We also lead a technical discussion on the requirements for standing up our data collection and analysis tools.

Once we know which systems will be included in the analysis, our engineers will work with the client to deploy the Production Analytics Solution. This will include configuring personalization and card delivery equipment as applicable and defined in the scope of the engagement. The data collection tools will collect the following data when personalization equipment is running:

- Machine state change, Idle, Running, Paused, Pausing, Resuming, Disconnected
- Job state change, Start, Running, Complete
- Cards produced; Cards rejected per job
- Job setup information for all running jobs

The data collected from each system is transmitted to a server where data will be stored and a basic dashboard can be seen. The data collection effort is not a single, one-time event.

The next phase of the methodology is to analyze the data. When the data collection efforts are completed, our engineers review the material collected. During this analysis period, the engineers and analysts attempt to determine factors that impact the production efficiency and produce an executive view of the efficiency based on the OEE framework.

Finally, our analysts prepare a client-specific report that provides in-depth analysis and detailed recommendations for taking corrective actions or remediation for improving production efficiency. This report includes an overview, methodology and background information, and detail sections that provide next-step actions and recommendations. Upon delivery of the report, the Entrust team works with the client to set up the next phase of the analysis. That phase involves revisiting those systems that have had corrective actions recommended as well as expanding the scope of the analyzed systems.

The systematic collection and analysis of the audit trail information can provide an effective tool for measuring and comparing performance between systems, job types, operators, and production shifts by normalizing the efficiency data with respect to varying job size. This data also provides an effective method for measuring the impact of changes to the production process by factoring out the impact of varying job sizes in day-to-day results.

CONCLUSION

Solve Your Card Issuance Efficiency Challenges with Entrust

By now you should have a better idea of how to measure and analyze your high-volume card issuance operations using the OEE framework for measurement. As a reminder, the OEE approach will provide an understanding of the primary areas of productivity losses and help you see, measure, and fix a problem. It also provides a standardized method of benchmarking progress.

In order to evaluate efficiency for varying average job sizes, we reviewed a measurement technique that allows production managers to accurately compare system performance without concern for the structure of the jobs. Considering the output constraints such as the job size and setup time, system service, and the production process are important to accurately estimate the actual output of the system.

Data analytics is key to solving the efficiency challenges prevalent in the card issuance market. The Production Analytics Solution provides you with self-sufficient, actionable digital intelligence and consultation to assist in real-time tracking and long-term trend analysis. Your extra efficiency gains could result in significant cost improvements, increased market share, faster card runs, and more revenue. Coupled with our Professional Services experts, this product is a true solution for analysis, recommendations, and guidance, enabling cost savings and providing a clear return on investment.

With continued use of the Production Analytics Solution, you can set future goals to identify and reduce downtime and idle time, identify patterns and trends over a period of time, analyze reject rates, compare systems, and understand what drives throughput differences.

For more information

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ABOUT ENTRUST CORPORATION

Entrust keeps the world moving safely by enabling trusted identities, payments, and data protection. Today more than ever, people demand seamless, secure experiences, whether they're crossing borders, making a purchase, accessing e-government services, or logging into corporate networks. Entrust offers an unmatched breadth of digital security and credential issuance solutions at the very heart of all these interactions. With more than 2,500 colleagues, a network of global partners, and customers in over 150 countries, it's no wonder the world's most entrusted organizations trust us.

Learn more at
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