2009 Winner

CIP4 International Print Production Innovation Award for Best Process Automation Implementation — North America

Ampersand Printing
Executive Summary — Ampersand is a full service offset printer located in Guelph, Canada, that currently employs 17 people. Our product portfolio includes high-end and high quality prints from full colour variable data digital printing, to high end commercial printing utilizing 10 Micron KODAK STACCATO screening.

With the implementation of a JDF/JMF connection between our MITSUBISHI press and our HIFLEX MIS system, we are now completely JDF wired (prepress, press and postpress). Our JDF network includes a JDF/JMF interface between HIFLEX MIS and KODAK Prinergy, as well as a JDF connection to our POLAR cutter.

The JDF project was carried out in two steps: (1.) JDF connectivity of equipment we already own (HIFLEX, KODAK and POLAR) and (2.) enlargement of the JDF network into the pressroom by purchasing and installing a new JDF compliant MITSUBISHI press in 2008.

The net present value (NPV) of the first project step was (based on empirical data) calculated with CAD 1,527,940 and the NPV of the now finished second step was (again based on empirical data) calculated with CAD 1,929,917. So the JDF/JMF network that we have established in our company has a five year net present value of CAD 3,457,857 for our company.

After the MITSUBISHI implementation we achieved complete JDF integration throughout our prepress, press and postpress departments. The automation has placed us light years ahead in efficiency.
Detailed Application Information

Section I. Background — Please provide a description of the subject workflow environment and conditions prior to implementation:

Company Profile

Ampersand is a second generation family-run company that offers full service offset printing. Currently 17 employees are dedicated to the production of high-end, high-quality products.

Our wide spectrum of products ranges from full colour variable data digital printing, to high end commercial printing utilizing 10 Micron KODAK STACCATO screening. We strive to deliver better products and increase competitiveness by employing the latest in print automation technology.

Now in its 30th year, we have positioned ourselves as one of the leading print service providers in Southern Ontario, Canada. By empowering highly skilled professionals with state-of-the-art technology, Ampersand strives to exceed client expectations every time.

We were one of the first Canadian companies to install computer-to-plate (CTP) technology. In 2004 we implemented the Kodak Prinergy digital workflow and CTP system with KODAK STACCATO screening.
Our fully equipped bindery is outfitted with Heidelberg machines: a Polar Cutter, Stahl folder, Cylinder for matrix scores, micro perforating and die-cutting, and a Stitchmaster Saddle Stitching system (equipped with both regular and loop stitching heads). We also possess high speed laminating equipment, wire-o and plastic coil binding systems, high capacity paper drilling equipment as well as automated clip sealing and shrink wrapping. In September 2006 we installed a new JDF-enabled cutter. HIFLEX MIS is used for order management and production planning and was introduced at the beginning of November 2005. JDF implementation began in April 2006.

In January 2007 we achieved Forest Stewardship Council (FSC) Certification. We felt this certification was absolutely necessary since people are becoming extremely sensitive to the environment, and this allows our customers to choose an environmentally friendly print alternative.

We opened a new state of the art facility in May of 2008 where we implemented a new MITSUBISHI Diamond 3000 LX press, adding to our digital workflow via JDF & JMF which we had already established between HIFLEX, KODAK and POLAR back in 2006/2007.
Workflow Prior to Implementation

We have been using JDF technology since 2006 when we first connected our HIFLEX MIS system to our KODAK Prinergy prepress system. We expanded this digital workflow in 2007 with the JDF bridge to our POLAR cutter. Since we have experienced enormous benefits from the very start of using JDF technology, we had a serious interest in broadening the process automation by the means of JDF connectivity. One example was the switch of NGP communication to ICS between HIFLEX and KODAK which we performed in February 2007. Although the JDF link, based on NGP, was working to our satisfaction, we saw the potential in using stripping parameters that could only be realized when switching the communication method to ICS standard. The result was the world-wide first ICS conforming JDF interface between MIS and prepress to be used.

In August 2007 we applied for a CIP4 Innovation Award and achieved second place in the category “Biggest improvement in efficiency and customer responsiveness.” With our pressroom being JDF/JMF connected today we have decided to apply again – and are now full stage JDF users (prepress, press and postpress). The automation of our new press has exceeded all our expectations. The results were so huge that we felt we could qualify for “Best cost/benefit realization and improvement in efficiency” as well as “Best Process Automation in North America”.

Since the JDF interface to KODAK and POLAR was already subject to our 2007 CIPPI application, we are focusing this application on our MITSUBISHI press integration project. So the chapters “workflow prior to implementation”, “resulting workflow” and “return on investment calculation” are not taking the achievements that we already realized with the 2006/2007 project into account. Nevertheless, Ampersand stands as a full stage (prepress, press and postpress) JDF/JMF-wired showcase.

Prior to the implementation of the MITSUBISHI Diamond 3000 LX we had no JDF enabled printing machines. A great deal of work had been done manually before the installation, consuming much of our time on the press floor:

Make-ready time

The make-ready time for our old printing machine was about 50 minutes per job. For each following signature we needed 30 minutes. We spent an enormous amount of time on make-ready, forcing us to work in several shifts because of the lacking time efficiency. From Monday to Thursday we would work in two shifts of 10 hours each, and from Friday to Sunday we had one shift of 12 hours.

Paper waste in production

We did not have the historic press settings available for reprint jobs, so the make-ready waste for reprints was equal to the make-ready waste of first editions. Sometimes (in less than 5% of all cases) it happened that the wrong PPF file was loaded into the machine. This was caused by human error since the pick-up of PPF files was done manually.
Preparation of signature data for the press workflow system

Job preparation was done manually on our Komori 2-Color and Mitsubishi 5-Color. The input of customer data and technical print data took about 8 min in total. The manual overwriting of signature data for subsequent signatures of the same job took 1 minute.

Section II. Objectives — Our company must achieve the highest degree of automation to remain successful in the very competitive Toronto printing market which has more printers per capita than any other region in North America. The competitive situation is increased also because of foreign competition, and an expanding online print sales market. For these reasons, it is essential that we continuously optimize the existing workflow in order to remain competitive.

The implementation of a JDF enabled MIS system was only the first step. The investment in the MIS and the simultaneous JDF connection with KODAK Prinergy and our POLAR cutter has already paid-off. With a Return on Investment (ROI) at that time of 1815.8% and a Net Present Value (NPV) of CAD 1,527,940.39 we have achieved fantastic results.

However, that was not enough for us. We decided to buy a JDF enabled printing machine, replacing the previous Komori 2-Color and the Mitsubishi 5-Color with a MITSUBISHI Diamond 3000 LX. The next step was connecting the HIFLEX MIS system and our new printing machine.

The new MITSUBISHI press and its JDF connection to the HIFLEX MIS helped us take the automation of our workflow to the next level.

In summation, our challenges for the JDF automation project were:

- Establishment of a JDF connection between HIFLEX MIS and our printing machine in order to further increase automation and efficiency in production
- Realization of automatic PPF assignment on the press system
- Avoidance of paper spoilage due to wrong color profile settings
- Eliminating the manual re-keying of data during job preparation as it is a primary source of errors and mistakes
- Reduction of make-ready time and increases in utilization percentage (ratio of production time to auxiliary- and down-time)
- Increased output with reduced work force; more value-added with less wage share

Section III. Methodology — The exchange of our printing machines was necessary. We decided to buy the Mitsubishi LX 3000 because we had a good experience with our former Mitsubishi press machine. We didn’t feel that there was any reason to change vendors.

We also knew that our MIS vendor HIFLEX had realized JDF installations between their system and Mitsubishi presses (e.g. PDC Tangen in Norway). This reinforced our decision to go with Mitsubishi, and ultimately led to our choice of the Diamond LX 3000.
Section IV. Implementation Story — Although this application focuses on the JDF/JMF interface between the HIFLEX MIS and MITSUBISHI Diamond press, we have summarized all implementation steps related to JDF/JMF in our company. This is due to the fact that the MITSUBISHI is entrenched in an already established JDF/JMF environment where it profits from the JDF/JMF links between HIFLEX and KODAK.

1 / Implementation of HIFLEX MIS

Start: November 2005
The HIFLEX Scheduling module is especially important for the JDF/JMF interface to our MITSUBISHI press that was installed later in Step 4. HIFLEX Scheduling functions as a JDF controller, sending and receiving information to/from our MITSUBISHI press (see step 4). It performs automatic planning for each cost center according to deadlines or priorities.

2 / Implementation of JDF-Connectivity between KODAK Prinergy and HIFLEX MIS

Start: April 2006
Achieved functions were (a.) automatic job creation in KODAK Prinergy Workflow System from HIFLEX, (b.) automatic feedback on approval status, processes and consumables (plates and proofs) from KODAK Prinergy Workflow System to HIFLEX, and (c.) tracking of chargeable or non-chargeable work and consumables from KODAK to HIFLEX.

The automatic job creation from HIFLEX to KODAK Prinergy Workflow System is especially relevant for the JDF/JMF workflow with our MITSUBISHI press. The job number and signature reference that HIFLEX send to KODAK Prinergy Workflow System is identical to the job number and signature reference that HIFLEX sends to the MITSUBISHI press. This permits automatic PPF assignment in the pressroom.

3 / Implementation of JDF-Connectivity to POLAR cutter

Start: February 2007
In February 2007 the communication method of the HIFLEX-KODAK link was changed from NGP to ICS standard, which made more functions available. Detailed data on

Screenshot of KODAK’s JMF prepress information feeding back into HIFLEX. The table shows prepress events (file delivery, approval status, proof making and plate exposure). Thumbnails of the pages are displayed and original PDF’s can be opened.
product parts and JDF Stripping Parameters could now be exchanged between HIFLEX to KODAK Prinergy Workflow System. This allowed us to use automatic loading of Preps templates based on the received Stripping Parameters and let us extract the cutting parameters for our JDF enabled POLAR cutter.

4 / Implementation of JDF-Connectivity between MITSUBISHI and HIFLEX MIS

Start: May 2008

The implementation of the bi-directional JDF/JMF link between the HIFLEX MIS and our MITSUBISHI press was easily established. With the installation of the new press, MITSUBISHI provided all the necessary software and equipment: IPC Server II, PPC Server II and the IPC press control system. From MITSUBISHI’s side we were on the cutting edge of JDF technology. HIFLEX technicians needed a few hours to configure their JDF/JMF interface. Communication was established via http protocol on the basis of HIFLEX’s JDF/JMF proxy. For the automatic link of PPF color profiles (KODAK’s data has to merge with HIFLEX’s data at the press console), there were minor modifications necessary in the HIFLEX-KODAK JDF link. The printing sheet number had to be added as an extra attribute on printing node level. All in all, it involved four days.
5 / Plans for the Future

We want to follow the increasing online-market for print products. Therefore we have just decided upon a JDF enabled Webshop solution from HIFLEX. We want to offer a 24/7 service to our customers, while reducing our costs for sales, quotations, and administration. At the same time we do not want to lose the production automation that we have achieved via JDF. Because of these reasons our choice to go with HIFLEX Webshop was strongly influenced by the fact that it is JDF enabled.

We go as far as to say that it is, in fact, the JDF connection between HIFLEX, KODAK, POLAR and MITSUBISHI that allows us to implement a Webshop solution. We believe that the implementation of Webshop is only truly possible with a fully integrated system that brings the maximum amount of automation.
Web-to-print will allow us to have “more of less”, meaning we can process more of the smaller orders we receive every day. We also hope to win over customers from other regions.

Section V. Resulting Workflow/Processes — Prior the implementation of JDF we had a paper-intensive system that lacked integration and required manual rework:

Starting Workflow
Prior to Implementation:
The details of this workflow are described in Section I.

In the previous chapters we explained the objectives and the implementation story, now we would like to talk about the effects of our resulting workflow:

In Summary, Ampersand benefits from the following effects of the JDF project:
- The JDF connection between HIFLEX and MITSUBISHI had further increased automation and efficiency in production
- We electronically transmit already defined job parameters instead of manually re-keying them – we work without typing errors and without the resulting production mistakes
- PPF files from KODAK are today automatically assigned to the jobs, so job preparation is much faster
- We avoid paper waste related to wrong color profile settings
- We could dramatically reduce make-ready time and increase sellable production hours
- We produce more in less time – we have seen a significant increase in our value-added while experiencing a reduction in wage costs

The effect of the new Mitsubishi press is the total JDF integration of our prepress, press and postpress systems.
Resulting Workflow in more Detail

The JDF link to our MITSUBISHI press is realized through three way communication between HIFLEX, KODAK and MITSUBISHI:

(1.) HIFLEX sends the job via JDF to KODAK and receives automatic JMF feedback on approval status, carried-out processes and consumed plates and proofs for automatic cost booking to the job.

(2.) HIFLEX sends the job via JDF to MITSUBISHI’s IPC Server II (IPC = “Intelligent Press Control”). This includes job data from administration, such as customer name, job number, product title and delivery date, run length; as well as technical data like format, paper thickness, ink names, and calculated paper consumption. Based on the JDF data both feeder and delivery as well as side lays, air pans for touch-less transfer system, air shower for anti slap device and impression pressure are preset.

(3.) KODAK sends the PPF color profiles to MITSUBISHI’s PPC Server II (PPC = “PrePress Connection”) which calculates ink key settings for the press.

(4.) At the IPC press control system (Mitsubishi’s machine terminal) the job data received from HIFLEX (via IPC Server II) and the ink key settings from KODAK (via PPC Server II) are automatically combined. This is only possible due to the JDF/JMF link between HIFLEX, MITSUBISHI and KODAK since it ensures a consistent numbering of all orders in all involved systems.

(5.) JMF data also flows back into HIFLEX Scheduling, allowing our Scheduler to monitor production progress from their workstation. The ability to monitor the press allows our scheduler to better plan depending upon the current state of our machinery. Live feedback is provided from the MITSUBISHI press, so the scheduler knows exactly what is going on and when, without having to run to the press for an update.

(6.) Our POLAR cutter receives JDF information for the automatic creation of the cutting program from KODAK Prinergy Workflow System. KODAK receives most of the imposition and signature data from HIFLEX via JDF Stripping.
Section VI. Optional Detail — My father (Mike McDonald) said: “The HIFLEX JDF data slips right through to our new Mitsubishi press, allowing our operators to achieve amazing make-ready times. We have been able to accomplish times as low as 6 minutes under the right conditions. This is an amazing accomplishment compared to our old press, sometimes saving an entire hour of preparation. None of this would be possible without the HIFLEX MIS System and its JDF data. The assistance provided by the JDF information basically functions as an additional member of the press crew.”

The Return on Investment (ROI) of the JDF Implementation of the new Mitsubishi Diamond LX 3000 at Ampersand accounts to 6121.5% within five years.
The Net Present Value (NPV) is CAD (Canadian Dollar) 1,929,917 which equals an Internal Rate of Return (IRR) of 2075.3%.

This implementation is based on empirical data. Since the implementation was carried out in June 2008 the calculation is not based on ideal assumptions but on empirical data taken from one year.

Our level of automation is extremely important in an environment where press operators are pushed to output large amounts of printed material in a small amount of time. By decreasing downtime and increasing productivity we are able to increase our efficiency and profits.

The benefits in detail:

1. DISCOUNT RATE

Although one year has already passed, all periods are discounted with a rate of return of 6%. The rate of return is the expected reward investor’s demand for investing in the project rather than carrying our alternative investment. The rate of return is often referred to as the discount, hurdle rate or company cost of capital. Without this consideration the ROI would be even higher.

2. BENEFITS

C. Reduced costs

To handle our work with the old Mitsubishi 5C we had to work 250 days per year: From Monday to Thursday with two shifts of ten hours, and from Friday to Sunday with one shift of 12 hours. All together we worked an average of 116 hours per week.

On the old Mitsubishi we had an annual 5,800 operation hours. With a utilization grade of 80% our pure production time was 4,640 hours. Those split into 1,900 make-ready hours and 2,740 print-run hours. Our total production costs where CAD 928,000 per year (hourly rate of CAD 200), and we produced 19 million sheets per year.
The new JDF connected MITSUBISHI is much more effective. Due to automatic job creation in the Mitsubishi IPC II-Servers, the preparation of signature data for the press workflow systems takes less time. The first signatures (1,200 per year) preparation was reduced by 34 minutes (16 minutes instead of 50 minutes). For the following signatures (1,800 per year) preparation was reduced by 22 minutes (from 30 minutes to 8 minutes). With an hourly cost rate of CAD 300 we now have achieved costs of CAD 810,000 per year. The costs of the new machine are accounted for in the 50% higher rate. During the last annual period we had a sheet output of 25 million.

While increasing our output we also reduced work hours so much that we could eliminate complete shifts. Now we are working five days (from Monday to Friday) with one 8 hour shift. Additionally, we produce at 2.5 days per week in a second 8 hour shift. The former 116 hours were reduced to 60 hours per week.

Thus we have reduced the annual costs by CAD 118,000 while at the same time the output increased by 6 million sheets, which represents a value of CAD 314,494. So in fact we reduced production costs by CAD 432,494 per year.

The preparation of job and sheet data in MITSUBISHI’s IPC Server was manually done before the previous job was finished (meaning while the machine was still running). As a result, the electronic transmission of JDF data for this purpose was not increasing the make-ready, but the manual work was erased. We calculate the costs for manual work preparation in IPC Server at CAD 100 per hour. In total, 190 hours have been eliminated for this task during the first year of our JDF interface, resulting in a saving of CAD 19,000. The value is calculated based on the time that is needed for the preparation of signatures (8 min for the first and 1 minute for following signatures).

In addition job data is much more reliable today. We have removed the need to re-enter already defined data, and have decreased the amount of human errors as a result. Moreover, we now have historic information and machine settings for the reprint of each job that had previously been printed on our new Mitsubishi.

D. Avoided costs

As automation technology makes job preparation more reliable, we avoid 400 sheets of waste per reprint signature (which are 600 signatures for reprints per year).

Due to automatic PPF assignment we avoid incorrect, manually input ink profile assignments that had been caused by human error. This happened with approximately 5 out of 100 jobs at our facility. For every incident we wasted approximately 500 sheets. By implementing the new Mitsubishi Press and connecting it to our HIFLEX MIS through JDF, we are now able to completely avoid these losses.

We have calculated the cost of these errors on an average sheet format and on an average paper price. We have found that the avoided costs since switching to our more automated workflow total up to approximately CAD 6,062 per year.
3. **COSTS**

**H. One time costs**

Our MIS supplier HIFLEX needed four days for the installation of the JDF interface to MITSUBISHI and for the modifications of the already running JDF prepress interface with KODAK. Further costs include:

- the Mitsubishi IPC II Server Software and licenses (CAD 10,000)
- the Mitsubishi IPC II Server Hardware (CAD 1,500)
- training on Mitsubishi IPC Server (CAD 2,400)
- internal startup costs (CAD 2,000)
- and IT ancillary costs (CAD 1,000).

**I. Recurring costs**

The recurring costs comprise of:

- External services (CAD 500 per year)
- Internal IT maintenance (CAD 2,000 per year)
## The calculation of the return on investment (ROI)

### 1 - DISCOUNT RATE

<table>
<thead>
<tr>
<th>Periods</th>
<th>Investment</th>
<th>1st year</th>
<th>2nd year</th>
<th>3rd year</th>
<th>4th year</th>
<th>5th year</th>
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<tbody>
<tr>
<td>A</td>
<td>Discount rate (expected Rate of Return)</td>
<td>6%</td>
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<tr>
<td>B</td>
<td>Discount factor</td>
<td>1.000</td>
<td>0.943</td>
<td>0.890</td>
<td>0.840</td>
<td>0.792</td>
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### 2 - BENEFITS

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<tr>
<th>Periods</th>
<th>Investment</th>
<th>1st year</th>
<th>2nd year</th>
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<tr>
<td>C</td>
<td>Reduced costs</td>
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<tr>
<td></td>
<td>1. Reduced costs in press production</td>
<td>CAD 432,494</td>
<td>CAD 432,494</td>
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<td>CAD 432,494</td>
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<td>2. Reduced work preparation of press</td>
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<td>presets</td>
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<td>D</td>
<td>Avoided costs</td>
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<td></td>
<td>1. Reduction in paper waste</td>
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<tr>
<td>E</td>
<td>Annual benefits (C+D)</td>
<td>CAD 465,640</td>
<td>CAD 465,640</td>
<td>CAD 465,640</td>
<td>CAD 465,640</td>
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<td>F</td>
<td>Cumulative benefits</td>
<td>CAD 465,640</td>
<td>CAD 931,280</td>
<td>CAD 1,396,919</td>
<td>CAD 1,862,559</td>
<td>CAD 2,328,199</td>
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<td>G</td>
<td>Discounted annual benefits = PV(E)</td>
<td>CAD 439,283</td>
<td>CAD 414,418</td>
<td>CAD 390,960</td>
<td>CAD 368,830</td>
<td>CAD 347,953</td>
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### 3 - COSTS

<table>
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<th>Periods</th>
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<th>1st year</th>
<th>2nd year</th>
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<td>H</td>
<td>One time costs</td>
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<td></td>
<td>Installation Hiflex 4 days</td>
<td>CAD 4,096</td>
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<tr>
<td></td>
<td>JDF/JMF License Mitsubishi IPC II</td>
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<td></td>
<td>Server</td>
<td>CAD 10,000</td>
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<tr>
<td></td>
<td>Mitsubishi IPC II Server (Hardware)</td>
<td>CAD 1,500</td>
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<td></td>
<td>Training Mitsubishi IPC II Server (2 days)</td>
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<td>Internal Startup-costs (1 week)</td>
<td>CAD 2,000</td>
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<td></td>
<td>IT ancillary infrastructure costs</td>
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<td>I</td>
<td>Recurring costs</td>
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<td></td>
<td>External Services</td>
<td>CAD 500</td>
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<td>Internal IT maintenance (20h)</td>
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<td>J</td>
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<td>CAD 2,500</td>
<td>CAD 2,500</td>
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<td>K</td>
<td>Cumulative costs</td>
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<td>Discounted annual costs = PV(J)</td>
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### NET VALUE

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<th>2nd year</th>
<th>3rd year</th>
<th>4th year</th>
<th>5th year</th>
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<tr>
<td>M</td>
<td>Annual net value = (E-J)</td>
<td>CAD -20,996</td>
<td>CAD 463,140</td>
<td>CAD 463,140</td>
<td>CAD 463,140</td>
<td>CAD 463,140</td>
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<td>N</td>
<td>Cumulative total</td>
<td>CAD -20,996</td>
<td>CAD 442,144</td>
<td>CAD 905,284</td>
<td>CAD 1,368,423</td>
<td>CAD 1,831,563</td>
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<td>O</td>
<td>Discounted annual value = PV(M)</td>
<td>CAD -20,996</td>
<td>CAD 436,924</td>
<td>CAD 412,193</td>
<td>CAD 388,861</td>
<td>CAD 366,850</td>
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<tr>
<td>ROI per Year = E/J</td>
<td>-100.0%</td>
<td>CAD 463,140</td>
<td>CAD 463,140</td>
<td>CAD 463,140</td>
<td>CAD 463,140</td>
<td>CAD 463,140</td>
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<tr>
<td>ROI Present Value = SUM(G)/SUM(L)</td>
<td>6121.5%</td>
<td>18525.6%</td>
<td>18525.6%</td>
<td>18525.6%</td>
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<td>18525.6%</td>
</tr>
</tbody>
</table>

### NET PRESENT VALUE

<table>
<thead>
<tr>
<th>Periods</th>
<th>Investment</th>
<th>1st year</th>
<th>2nd year</th>
<th>3rd year</th>
<th>4th year</th>
<th>5th year</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Net Present Value (SUM(O))</td>
<td>CAD 1,929,917</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### INTERNAL RATE OF RETURN

<table>
<thead>
<tr>
<th>Periods</th>
<th>Investment</th>
<th>1st year</th>
<th>2nd year</th>
<th>3rd year</th>
<th>4th year</th>
<th>5th year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>IRR (Internal Rate of Return)</td>
<td>2075.3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


**About project financial analyses**

**Return on Investment**

The term Return on Investment (ROI) is frequently used in different ways. In financial circles, the strict meaning of Return on Investment (ROI) is Return on Invested Capital, a measure of company performance. The company's total capital is divided into the company's income (before interest, taxes, or dividends are subtracted).

Most business people use "ROI" simply to mean the "Return" (incremental gain) from an action, divided by the cost of that action. In this sense, an investment that costs CAD 100 and pays back CAD 150 after a short period of time has a 50% ROI. This is exactly how it is used in the financial analysis of Ampersand’s JDF implementation.

**Net Cash Flow (can be found in the line 'Annual Net Value' (N))**

Cash flow, like income, focuses on the difference between money coming in and money going out over a time period. (Net Cash Flow = Cash Inflows - Cash Outflows). Cash flow results do not include some items found in the income statement, such as depreciation expense. Depreciation expense, for example, does not represent an actual cash payment during the reporting period, but rather an accounting charge against earnings. As a result, depreciation expense is not a "cash outflow" in the above financial analysis.

**Discounted Cash Flow (DCF) (can be found in the line 'Discounted annual value' (P))**

The DCF is a cash flow summary that has been adjusted to reflect the time value of money. It is an important criterion in evaluating or comparing investments or purchases. All things being equal, the purchase or investment associated with the larger DCF is the better decision. DCF makes use of the Present Value concept, the idea that money you have now should be valued more than an identical amount you would receive in the future. Why? The money you have now could (in principle) be invested now and gain return or interest, between now and the future time (interest rate used in the above financial analysis is 8%, (A)). Money you will not have until some future time cannot be used now. Therefore, the future money's value is discounted in financial evaluation, to reflect its lesser value. What that future money is worth today is called its "Present Value".

**Net Present Value (can be found in the line ' Net Present Value ' (Q))**

The net present value is a form of calculating discounted cash flow. It encompasses the process of calculating the discount of a series of amounts of cash at future dates, and summing them. Therefore, the height of the net present value is dependant on the length of the period for the project financial analysis. The period which we have chosen for the financial analysis of Ampersand’s JDF project is five years.

**Internal Rate of Return (IRR)**

The IRR for an investment is the discount rate for which the total present value of future cash flows equals the cost of the investment. It is the interest rate that produces a 0 NPV. Another way to think of IRR is this: IRR tells you just how high interest rates would have to go in order to "wipe out" the value of this investment. Like DCF, the IRR is a cash flow summary that has been adjusted to reflect the time value of money. The IRR view of the cash flow stream is essentially an investment view: money will be paid out in order to bring in gains. The higher an investment's IRR, the better the investments return relative to its cost and the lower the risk.