Best cost/benefit realization as a result of process automation implementation

First Place Winner
2007 Jürgen Schönhut Memorial CIPPI Award
Best cost/benefit realization as a result of process automation implementation
PDC Tangen

Abstract:

- First Scandinavian printer that implemented JDF connectivity
- To date six printing presses (37 units from Mitsubishi and Komori), three folding machines (MBO), and prepress (Kodak) are networked with our Management Information System (Hiflex MIS)
- Today prepress receives Stripping and folders are preset with type and position of folds, folding catalog, and details about side or head alignment
- In June 2007 we produced the first fully automated order:
  1. Hiflex sends job init data as well as StrippingParams to Prinergy
  2. Preps Template is loaded automatically based on the received StrippingParams
  3. Customer receives email notification and can access JDF created job in Kodak’s InSite web portal
  4. Upload of file by customer
  5. Data is automatically refined: pre-ripping, normalizing, color matching, trapping
  6. Using Automated Page Assignment (APA) function in Prinergy the refined pages are automatically placed on the loaded imposition templates.
  7. Customer checks refined data using InSite and gives approval to pages and forms.
  8. Prepress operator receives email message that pages and forms are approved and then triggers plate exposure. (First manual process since order was launched)
  9. PPF file is generated upon plate exposure and forwarded to the press systems
  10. PPF is automatically picked-up and assigned to signature data in the press systems’ server
  11. JDF for press presetting is sent from Hiflex Scheduling to the press management system
  12. JDF for postpress presetting is sent from Hiflex Scheduling to the postpress management system
- The results of the projects have exceeded our expectations by far
- Productivity increase on presses: 25%, productivity increase on folders 15%
- Overall increase of transparency, job tracking, planning horizon, flexibility
- ROI is more than 1847.2% within five years (which means that the investment is paid back 19.47 times).
- The direct effect of the JDF connectivity project was an increase in the turnover by 20% (EUR 5.2 Mio) in the relevant time period (2006 compared to 2005). The profit after taxes was increased by almost 900%.
- The cash value (NPV) is EUR 5,180,906 / USD 7,131,880.25
Application Outline

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

COMPANY DETAILS

Family run PDC Tangen was founded in 1968. It developed to one of the largest offset printers in Norway today. Whereas our sales and design office is situated directly in Oslo, production facilities are located in Aurskog (50 kilometers outside of Oslo). We offer print production as well as web publishing.

PDC Tangen is a full service offset printer with 110 employees to date (35 of them working with page production). Prepress operations are managed with Kodak InSite and Kodak’s PDF Workflow System, and plates are exposed on a Kodak CTP plate setter 3244 and a Kodak CTP Magnus. Production is done on 39 printing units in size 3, 4 and 6 from different vendors such as Komori and Mitsubishi, as well as Heidelberg. 37 units (Komori, Mitsubishi) are connected to Hiflex MIS via JDF. After building a new hall beginning of 2006, a post press department with three MBO folding machines (also JDF connected to Hiflex MIS) and one Muller Martini saddlestitcher were included into our line of services.

Our product portfolio includes books (50%, especially school books), periodicals, catalogues, and brochures.

SITUATION PRIOR TO IMPLEMENTATION

Order Preparation for Production

The administration system (order management), the applications used for production planning, and the production systems were not connected to each other. This resulted in time consuming and error prone manual re-work in the area of data processing, and in delayed communication of actual job status. Consequently, we lost valuable production time.

Customer approvals were entered manually into the administration system. A paper printout of the job ticket was forwarded to the CTP department and, further on to the press room as soon as the job was ready for print. Customer and production data had to be re-typed into the according production systems.

Any job modifications were entered into the administration system and involved a new printout of the updated job ticket which then replaced the former job ticket. The new job ticket had to be carried to the current production place (either prepress or press department).

Each day we held a production meeting of approximately 30 minutes with 5 persons involved. The discussed planning was mainly done on paper.
The manager of the printing department received a paper list with jobs twice or three times a day. The list included all jobs ready for print. He then manually fine-tuned the order of the jobs by adding priority numbers into our former system. The job list was then rearranged. There was no graphical display of planned jobs based on the capacities/availabilities of the machines in the production planning application.

Job preparations for the presses were done manually in Mitsubishi IPC II Servers and K-Station. The input of customer data and technical print data took about 8 min in total. For following signatures of the same job the first signature was overwritten and the relevant PPF color profile was loaded anew. In effect no record was kept that contained information of all signatures of the jobs (only the last printed signature “survived”).

When reprinting jobs it was time consuming and effortful to gather the according data from different databases. This situation was troublesome especially because of our job structure: 50% of the jobs are school books which are regularly reprinted.

There was no chance to increase the level of automation with the given technology.

**Job tracking during production**

Real-time tracking of the job status including last-minute modifications were not possible. Production data and job status were not accessible to everyone involved in production. Time consuming non-electronic communication processes such as phone calls and visits of different offices or departments were common. Naturally, important info reached the relevant recipient with time delay. This involved a considerable loss of flexibility and transparency and therefore of valuable production time.

When customers were checking on the order status or wanted to communicate new or additional information regarding their jobs, the lack of real time status information throughout the plant made it time-consuming for customer service representatives (CSR’s) to respond to their customer inquiries. The CSR usually had to call the customer back after checking the job status with the prepress or press departments. Several phone calls or a tour of the company in order to ask the according member of staff were involved in this workflow.

**Paper waste in production**

We did not have the historic press settings available for reprint jobs so that the make ready waste for reprints was equal to the make ready waste for 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. Usually this was not noticed immediately and changing the color profile meant spoilage of at least 500 sheets in such incidents.

**Reporting of production times**

Production data was manually noted on the time sheet. Time sheets were forwarded to the accounting department where the data was entered into the administration system. Data entry of one job was usually finished not faster than one day after the manual time sheets had been passed in. This delayed shop floor data collection resulted in delayed invoicing, allowed only retrospective analysis of production data, and led to a reduced planning horizon.

**Stock taking**

In our inventory checks of plates there was always a difference between actual consumption and consumed plates that were registered. Though investigations were carried out (on average 4 hours per month) many of the exposed (“lost”) plates could not be allocated to a job and therefore could not be accounted for.
With regard to Norway’s very high level of wages (especially in comparison with the Eastern countries), we considered the step into automation technology as a strategic decision in order to decrease the proportion of the wages in the added-value chain. This was to be achieved by increased efficiency and productivity as well as a better handling of deadlines.

Successful case studies about real-life JDF implementations convinced us, that JDF is the best means on the market for automating our processes and increasing efficiency throughout production.

The change was initiated when we realized that no further upgrade of our administration system in use at that time (end of 2004) was possible. We faced technical limitations, and also a new official upgrade of our system was not compatible with our self-made customized version of that same system. As a result, no further increase of administrative efficiency was rendered possible.

The choice of HiFlex MIS was triggered by (a) the supplier’s very high level of experience as regards the printing business and JDF real-life implementations (highest numbers of JDF installations), as well as (b) by the fact that the system’s architecture (particularly the estimating and scheduling modules) convinced us to meet our needs.
Together with the decision to invest into a new Management Information System and IT infrastructure, our primary objective was the integration of all systems and applications for computer integrated manufacturing (CIM). Consequently, we looked out for fully JDF compatibility of the new components.

**Overview of the criteria on which the goals were established:**

Any change should:

- Increase efficiency throughout production and administration by at least 10%
- Increase automation - both in the field of administration and of production - in order to gain more transparency and flexibility throughout production
- Increase customer responsiveness
- Have no negative impact on the customer
- Decrease the wages share of the add value
- Allow JDF functionality between administration and production
- Reduce the error risk (one database – multiple usage of information)
- Lower material usage (especially paper waste)
- Provide e-business solution with both customers and suppliers

We aimed at a return on their investment after 2 years. In the lifecycle of the investment (5 years were calculated) the investment should have paid back three times (= ROI of 200%). The Net Present Value (NPV) was estimated with EUR 500,000,-- / USD 688,133.24 (discounted with 6%) which equals an Internal Rate of Return (IRR) of 100%.

**Section III. Methodology** — Please provide a description of the process of selecting a solution, including alternatives and deciding factors:

When selecting the solution to increase process automation technology we considered the Management Information System as the most important component. The MIS stores and provides all relevant data and therefore is the core of the automated production process. Our focus therefore lay in finding a new high-performance system to connect to our technical equipment in the prepress, press, and postpress department.

We were absolutely aware of the fact that a switch from one administration system to another one involves costs and efforts and must therefore be a sustainable and expandable solution. As the MIS is the fundamental part of the company we recognized its capabilities as a crucial success factor.

When selecting an MIS supplier we considered the following points:

- Good references and very high level of practical experience
- Not a supplier – but a partner; a good ”feeling” for the supplier
- R&D resources – a partner for the future
- Practical document handling (Office/Outlook)
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- E-business module at hand
- Improved estimation and electronic scheduling system / higher degree of automation

We went for a sustainable solution (Hiflex MIS) that allows the seamless future integration of further systems and applications, thus providing the basis to constantly proceed with Computer Integrated Manufacturing (CIM). In this area it was again an important factor that the open standard JDF allows a standardized, cross-vendor communication between our different systems (Kodak Prinergy, Komori K-Station, Mitsubishi IPC II Server, and Hiflex MIS).

Section IV. Implementation Story — Please provide a description of the implementation effort including timeline, participants, critical path/milestones, obstacles overcome (if any), training and testing:

The implementation started on 1st November 2005 and progressed in several steps. To date the Hiflex MIS is integrated with Kodak Prinergy PDF Workflow System, the Mitsubishi presses, the Komori press, and the MBO folders.

1. IMPLEMENTATION OF THE HIFLEX MIS

Start: November 2005
Hiflex MIS Release 2004

Implementation of Hiflex MIS, introduction of Hiflex Estimate and Hiflex Order Book for administrative processing, estimating, job costing, invoicing, and document management.

Installation of Hiflex Scheduling and Hiflex Shop Floor Data Collection (Hiflex SFDC). Hiflex Scheduling (JDF controller) handles the automatic planning for each cost center according to deadlines or priorities. Hiflex SFDC is used for decentralized Shop Floor Data Collection.

2. IMPLEMENTATION OF JDF CONNECTIVITY TO KOMORI PRESSES

Start: February/March 2006
Komori K-Station
Communication method: HTTP

Implementation of the JDF connectivity between the MIS and Komori K-Stations of the Komori presses. Automatic ‘Job Create’ in the Komori system. The Komori presses receive job information (e.g. customer name, job number, product designation) and relevant printing parameters (format, paper, length of run, number of plates and inks) via JDF from the Hiflex MIS.

JMF feedback from Komori K-Station is fed into the MIS. Production data such as progress on the job (in percent), good sheets and waste, speed, and status of the machine (e.g. idle, set up, preparing, washing, production in progress). This data is automatically transferred into Hiflex Scheduling and displayed in the JMF monitor.
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Image 3: Screenshot from Komori K-Station showing the job order as received via JDF link between Hiflex and K-Station.

Image 4: Screenshot from Komori Press Control Console displaying job data as received from Hiflex MIS via the JDF interface to Komori K-Station.
3. IMPLEMENTATION OF JDF CONNECTIVITY TO MITSUBISHI PRESSES

Start: April 2006
Mitsubishi IPC-II Server
Communication method: HTTP

Implementation of the JDF connectivity between Hiflex MIS and Mitsubishi IPC-II Server for the five Mitsubishi presses. Automatic ‘Job Create’ in the Mitsubishi system. The Mitsubishi presses receive job information (e.g. customer name, job number, product designation, delivery date to binder, with/without perfecting) and relevant printing parameters (format, paper, length of run, number of plates and inks, calculated paper consumption) via JDF from the Hiflex MIS.

JMF feedback from the Mitsubishi IPC Server is fed into the MIS. Production data such as progress on the job (in percent), good sheets and waste, speed, and status of the machine (e.g. idle, set up, preparing, washing, production in progress). This data is automatically transferred into Hiflex Scheduling and displayed in the JMF monitor.

This implementation was the worldwide first real-life JDF-link between a Management Information System (Hiflex MIS) and Mitsubishi printing presses.

Image 5: JOblist in Mitsubishi showing the plate previews (front and back).
4. IMPLEMENTATION OF JDF CONNECTIVITY TO KODAK PRINERGY AND INSITE

Start: May 2006
JDF-Specification Version 1.2
Kodak Prinergy (v.2.3),
Kodak InSite
Communication method: HTTP

As the link to Prinergy (which is handled through Kodak’s “Synapse Link”), had already been installed at various joint Hiflex-Kodak customers, it was considered proven technology prior to implementation. There was a minor obstacle which concerned the automated assignment of the PPF file (created by Prinergy) with the JDF created job in Mitsubishi IPC-II Server. This was overcome with a small modification within the IPC-II Server.

The link between Hiflex and Prinergy enables automatic cost booking: Transfer of time and material costs (marked as included, extra chargeable, error etc.) from Prinergy to Hiflex. Prepress events and approvals are translated to cost center and material data in Hiflex (no manual entry of prepress production data and shop floor data collection is now required).

Kodak InSite - the Internet portal into the Kodak Prinergy Workflow System - is used by authorized customers for job submission, job-status tracking, and remote proofing or approval. Information about uploaded files, proofs and approvals is transferred from Prinergy to Hiflex MIS via JDF.
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Image 7: Illustration of the connectivity between Hiflex MIS, Kodak Prinergy, and Synapse InSite. Synapse InSite, which is connected to Kodak Prinergy via the Internet, is used for job submission, job-status tracking, and remote proofing and approval. InSite communicates with Prinergy, and Prinergy communicates via Synapse Link (JDF/JMF connector) to Hiflex MIS.
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Image 8.1: Screenshot from Kodak InSite – Customers can transfer job data in their personal login area on the Web Portal System.

Image 8.2: Screenshot from Kodak InSite – After file transfer and preflight check customers are prompted to approve on a single page basis. Any comments can also be added.

Image 8.3: Screenshot from Kodak InSite – Before submitting the final approval customers can open each page (PDF) in order to check the details.

Image 8.4: Screenshot from Kodak InSite – successful approvals are displayed for each page.
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Image 9.1: Screenshot from Kodak Prinergy – Display of job list including job status.

Image 9.2: Screenshot from Kodak Prinergy – After the allocation of pages to signatures (imposition scheme) the proofing takes place. Within the process dialog the operator can select from a drop down list if the “work type” is original work, rework (chargeable or not) or author’s corrections (chargeable or not). The operator’s selection will be part of the JMF Messaging and influences the job tracking and cost booking in Hiflex MIS.
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Image 10: Screenshot from Hiflex MIS – Thumbnail preview of a page in Hiflex MIS. A click on a page opens the preview in the left box. This PDF can be opened in Acrobat by a further click.

Image 11: Screenshot from Hiflex MIS displaying of material consumption and extra costs as received from Prinergy in real-time.
5. UPDATE KODAK PRINERGY/BUSINESS LINK 3.0 TO ICS

Start: May 2007
JDF-Specification Version 1.2, Communication method: HTTP,
Kodak Prinergy (v.3.0) ICS compatible

This is second ICS compatible system with on-time cost booking all over the world (with the first one being Ampersand in Canada).

Based on StrippingParams from Hiflex MIS, Kodak chooses suitable existing template and automatically adds the pages.

Product parts exchange between Hiflex and Kodak Prinergy: whereas before it was only the job header that was transferred, Kodak now receives also product parts (e.g. cover and content).

StrippingParams sent by Hiflex are used to load correct Preps template into Prinergy. In June 2007 we produced the first fully automated order:

1. Hiflex sends job init data as well as StrippingParams to Prinergy
2. Preps Template is loaded automatically based on the received StrippingParams
3. Customer receives email notification and can access JDF created job in Kodak’s InSite web portal
4. Upload of file by customer
5. Data is automatically refined: pre-ripping, normalizing, color matching, trapping
6. Using Automated Page Assignment (APA) function in Prinergy the refined pages are automatically placed on the loaded imposition templates.
7. Customer checks refined data using InSite and gives approval to pages and forms.
8. Prepress operator receives email message that pages and forms are approved and then triggers plate exposure. (First manual process since order was launched)
9. PPF file is generated upon plate exposure and forwarded to the press systems
10. PPF is automatically picked-up and assigned to signature data in the press systems’ server
11. JDF for press presetting is sent from Hiflex Scheduling to the press management system

6. IMPLEMENTATION OF JDF CONNECTIVITY TO MBO FOLDER

Start: June 2007
JDF-Specification Version 1.2, Communication method: HTTP
Hiflex MIS
MBO Datamanager

Automatic ‘Job Create’ triggered from Hiflex in MBO Datamanager. Hiflex MIS system transfers administrative data (job number, customer name, dates, print run, etc.) and technical data (e.g. number, type and position of folds, folding catalog, and details about side or head alignment) directly to the MBO Datamanager for automatic make-ready.
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MBO sends JMF feedback about the progress on the job, speed, good sheets and waste to the Hiflex Scheduling application.

7. PLANS FOR THE FUTURE

Start: Summer/Autumn 2007

- Further finishing equipment (Muller Martini Saddle Stitcher) is to be included soon into the network in order to increase productivity on the saddle stitcher as well (Today, our internal capacity covers maximum 80% of our total stitching needs). We will then be able to control all jobs completely via JDF/JMF-connectivity.

- Update to Preps 6.0 in order to create new templates on-the-fly based on Hiflex StrippingParams.

- Implement “hands-off production” (without any manual interference) with the integration of Hiflex eBusiness module. Customers can then initiate jobs via secured login area of our website. These created jobs are triggering JDF files to internal production systems (first of all: Kodak’s Prinergy System). As the customer is already logged into the Hiflex eBusiness system (which is part of our website) they have also access to InSite functions. This is because Hiflex and Kodak can share the same username/password, so that our customers need only one login procedure. With “hands-off production” we aim at letting the customer instead of the CSR trigger the automated production up to ready for plate exposure.

- Modification of CIP3 PPF to JDF 1.2 ICS (Prepress/Press) compliant files, so that Hiflex receives CIP3 (PPF-) files from Kodak Prinergy and combines this data (after modification) with JDF-data (CIP3 is converted into CIP4). Komori K-Station / Mitsubishi IPC II Server will then receive a single data stream containing both the JDF and PPF information already linked to each other.

- Integration of suppliers (paper, outwork binders etc).

Section V. Resulting Workflow/Processes — A description of the resulting workflow, including any applicable workflow or process diagrams.

Today, the information flow from our administration system (Hiflex MIS) into production (Kodak prepress, Komori and Mitsubishi presses, MBO folders) is an integrated, cross-vendor solution. Today we have 10 of 11 machines integrated into the JDF workflow with the remaining machine – the Muller Martini saddle Stitcher - very soon to be integrated.

The entire process of networking our operations is coordinated and managed by the Hiflex MIS (centralized data pool), functioning as a JDF controller. An exact description of the production sequence is generated during preliminary calculations and initial job costing. Upon order entry relevant technical job data (e.g. time values for production, format, colors etc.) are automatically exported to the Hiflex Scheduling application (JDF Controller). Precise time values for every sheet and signature are transferred from the technical estimate to the scheduling.

Once the data has been captured in the Hiflex system it can be made available to Kodak Prinergy, Komori K-Station, Mitsubishi IPC Server II, and MBO Datamanager via the JDF interfaces. Feedback from production automatically flows back into Hiflex order book, Hiflex scheduling and Hiflex shop floor data collection and constantly updates the MIS.

Our workflow after the process automation implementation is characterized by enhanced transparency and flexibility. This helped us to realize considerable time and cost savings, win valuable production time, and improve customer responsiveness.
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Image 12: Illustration of the data exchange between the administration system (Hiflex MIS) and production via JDF/JMF at PDC Tangen
THE RESULTING WORKFLOW IN DETAIL

Order preparation for production

We now have an increased level of automation due to JDF-connectivity between Hiflex MIS, Kodak, Komori, and Mitsubishi. Data relevant for production only has to be entered once into the Hiflex MIS and subsequent systems are provided with the necessary job specifications. Redundant manual data entry is overcome. Any modification of the order or of the scheduling (re-scheduling) is entered in Hiflex and then via JDF transferred to Kodak Prinergy, Komori K-Station or the Mitsubishi IPC Servers, where jobs are automatically updated.

The Workflow in Detail:

As soon as an estimate evolves into a live job the Hiflex MIS automatically creates a job in Prinergy. The job is also accessible for our customers through Kodak’s web portal system InSite. Feedback from InSite is fed back to Prinergy which again delivers feedback to Hiflex via JDF/JMF that includes:

- Author and proof reader corrections, as well as information (whether the correction is chargeable or not) are passed together with explanatory comments to the Hiflex order book, where chargeable items are automatically marked in red in order to make them prominent.

- Time, material, and error costs (marked as included or extra chargeable).

- Information on subsequent activities, i.e. about processing and output tasks during actual production.

All orders are automatically displayed in the Hiflex scheduling system, which is steadily updated. The scheduler carries out the rough planning of the job sequence. This means he can manually change the priority of the jobs according to both job status (e.g. plates exposed reported via Kodak-Hiflex JMF link) and capacity on the digital planning board.

Job scheduling is fully automated down to single signatures or sheets, and carried out for each cost center according to deadline or priorities. With the arrival of the printouts of the electronic job tickets (including proofs) in the press department, the final planning is managed with the Hiflex scheduling system (which simultaneously acts as a JDF controller) to determine the final job sequence and to send job information via JDF to the press systems. The scheduler has a precise insight into free capacities or schedule overlaps. He is much more efficient today and handles many more jobs than before implementation.

As production meetings today are held with direct access to Hiflex scheduling application (and are no longer done with paper and pencil) we now handle more jobs (press jobs and postpress jobs) in the course of our 30-minutes lasting production meetings with the same number of staff.

Just before the job goes to the press, the Komori K-Station and the Mitsubishi IPC Servers receive all administrative data (order ID, customer) and technical data (the relevant printing parameters such as information about the product, the format, the press run, the paper, the number of plates/colors) via JDF from the Hiflex MIS. No manual entry of the job data into the press machine systems is required. This ensures precision and matching data on the job tickets and the jobs stored in the press machine systems. The press operator is shown the digital job ticket before the job starts. Using this, he can check for the current instructions on the job.

When reprinting jobs we have direct access to former job data. This includes historic job data and color settings which are no longer overwritten. If a job for instance consists of 8 signatures, all eight according color profiles are saved today.
In correspondence, the MBO Datamanager of the folding machines receives JDF job data for automatic make-ready as soon as folding is ready to start. Job data, again, includes administrative data (order ID, customer) and technical data (e.g. number, type and position of folds, folding catalog, and details about side or head alignment). Data transfer via JDF reduced make-ready time from 15 to 5 minutes. During folding JMF feedback constantly flows back into Hiflex MIS.

**Job tracking during production**

Real-time tracking of job data, including last-minute modification, highly improved our internal communication processes and enhanced transparency and flexibility very much. Hiflex MIS regularly receives feedback from production and is always up-to-date regarding the job status. Automation of standard information saves us a lot of time today, and there is no running around the company with documents or updated job tickets any longer.

Image 13: Screenshot from Hiflex scheduling application (digital planning board) as used at PDC Tangen. Hiflex Scheduling displays the planning of the job sequence as well as JMF feedback from production (highlighted, see right bottom corner).
The planning and scheduling system is constantly kept up-to-date with the status of all jobs entered into the MIS. And data entry into the Hiflex SFDC is simplified by giving the press operator the possibility to extract the produced amount of good sheets from the JMF stream the printing press sends back.

**Paper waste**

The use of historic press settings for reprint jobs clearly reduced our paper waste. Moreover, the formerly produced spoilage caused through human errors (wrong manual pick-up of PPF-files) is avoided today. This was managed through automated assignment of the PPF file (created by Prinergy) with the JDF created job in K-Station or IPC-II Server.
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Reporting of production times

Data about production times and working hours are directly entered into the Hiflex Shop Floor Data Collection System (Hiflex SFDC). Production data from the presses is fed back to Hiflex MIS via JDF/JMF in real-time and automatically transferred into Hiflex Scheduling and partly into Hiflex SFDC. Today, actually produced costs as well as consumed material are all accurately captured in the MIS and our invoicing is more reliable and one day faster.

Inventory

Due to the link between Hiflex and Prinergy, material consumption and cost center times from prepress are automatically booked against the job in Hiflex. No data or plates can be lost because of a forgotten entry. Automatic transfer of information concerning times, material, house corrections (error costs), and chargeable/non-chargeable authors’ corrections makes the tracking of costs for invoicing faster, easier, and more reliable.

Our inventory checks of plates do no longer show differences between actual consumption and consumed plates that were registered so that all exposed plates can be allocated to a job and therefore accounted for.
Section VI. Best cost/benefit realization as a result of process automation implementation — Please Provide a quantitative analysis of the hard and soft ROI factors expected and realized, to include either breakeven analysis, IRR or NPV determination of hard factors and testimonial evidence from users or customers as to the realization of soft benefits.

The Return on Investment (ROI) of the JDF implementation at PDC Tangen is 1847.2% within five years (which means that the investment is paid back 19.47 times). The Net Present Value (NPV) is EUR 5,180,906,— or USD 7,131,880.25 which equals an Internal Rate of Return (IRR) of 969.7%.

The implementation was carried out in April 2006, and the calculation is based on empirical data taken from 2006. Although only one period (2006) has already fully passed, all periods are discounted with a rate of return of 6%. The rate of return is the expected reward investors’ demand for investing in the project rather than carrying out alternative investments. The rate of return is often referred to as the discount, interest, hurdle rate, or company cost of capital. Without this consideration the ROI would be even higher.

The overall effect of improved process automation is a productivity increase of 25%. This is also cross-checked with the increase of the net profit before taxes (which was taken from the company’s profit and loss statement), which results in the same value. For 2006 this is empirical and proven data.

THE BENEFITS

The direct effect of the JDF connectivity project was an increase in the turnover by 20% (EUR 5.2 Mio) in the relevant time period (2006 compared to 2005). The profit after taxes was increased by almost 900%.

INCREASED ADDED VALUE (C)

1. Increase in sold press production

We measured a productivity increase in the press department of 25% after JDF was put in force. Since JDF started in April 2006 the effect of increased production output for 2006 is 20% which correlates with our turnover increase (25% x 9/12; productivity increase for a complete year: 25%).

2. Increase in sold folder production

Integration of the MBO folders started in July 2007. Today the folders are running in 1 shift, but from September 2007 onwards we are planning to run two shifts on all postpress machines. This will result in more jobs on the folders and was included into the calculation (We have always enough jobs on the folding machines, because we could also fold sheets before we send them to glueing/sewing, what we don’t do at the moment). The direct effect of integrating the folders via

Image 16: The text on the T-shirt is saying “Quality print operator at PDC Tangen. I’m using JDF”. All employees got this T-shirt on the kick-off day we started to use JDF in full scale.
JDF is a reduction of make-ready time from formerly 15 to now 5 minutes. The savings sum up to approximately 9,47% of the total production hours. Based on the fact that JDF positively influences planning horizon, job tracking, transparency etc., the assumption was made that productivity is increased by a total of 15%. Time-savings, therefore, sum up to 220 hours for 2007 [(220 x 2/12 x 8 + 220 x 4/12 x 16) x 0,15] and 528 hours for 2008-10 [(220 x 16) x 0,15].

In order to calculate the increase of added value for the presses and the folders, the extra productive hours were multiplied with the hourly cost rate of the respective machines. The direct costs are subtracted.

For the periods 2007, 2008, 2009 and 2010 the assumption was made that the number of productive hours and the direct costs will stay unchanged (increase compared to 2006 / 2007 of + 0%).

**REDUCED COSTS (D)**

The integration of the printing presses and of the prepress led to cost reductions in the field of prepress and press operations:

1. **Reduced work in prepress:**

   **Automatic job creation in Kodak Prinergy:**
   Time savings of 2 minutes per manual job creation in Prinergy multiplied with 3000 prepress jobs per year = 6000 / 220 production days per year → approximately 30 minutes per day.

   **Automatic cost booking:**
   1. Saves prepress operators about 30 minutes per day in Shop Floor Data Collection.
   2. Monthly stock-taking of plates was reduced by 4 hours per month (due to automatic JDF/JMF bookings)

   With an internal hourly cost rate for a prepress operator of NOK 700,-- (EUR 86.80) (Including all direct and indirect costs) the costs of the saved working time sum up to EUR 16.080,-- per year (30 min/day on job creation + 30 min/day on SFDC + 4 hrs/month on stock-taking). As JDF connectivity to Kodak started in May 2006, the actual sum for 2006 is EUR 10.720,-- (16.080,-- x 8/12).

2. **Reduced work in prepress due to Stripping**

Due to automatic stripping and the InSite JDF Link the prepress operator saves 41 minutes per automated jobs:

<table>
<thead>
<tr>
<th>Process</th>
<th>Hiflex / Kodak JDF-link</th>
<th>Hiflex / InSite / Prinergy / JDF-link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer calls, PDF's are ready</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>CSR find files, copy into Prinergy, update MIS</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>CTP operator open job, start refine</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Imposition, print paper-proofs, packing</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>CSR call/e-mail follow up paper-proofs</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>CSR proofs handling to CTP</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>CSR update Hiflex, message to CTP operator</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>CIP3/PPF files to print interface</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>41 minutes</strong></td>
<td><strong>0 minutes</strong></td>
</tr>
</tbody>
</table>
Best cost/benefit realization as a result of process automation implementation

Starting in June 2007, the ROI calculation works with an assumed increasing number of jobs that are produced via automatic stripping / InSite / JDF. For the remaining months in 2007 it was assumed that 13.5% of all prepress jobs will be automatically produced this way (for 2008 30%, for 2009 60% and for 2010 90%). So in effect 405 (out of 3000) jobs in 2007, 1000 (out of 3000) jobs in 2008, 2000 (out of 3000) jobs in 2009, 2700 (out of 3000) jobs in 2010 will be automated this way. ROI calculation: the number of jobs x 41 minutes saving per automated job number x hourly cost rate of prepress operator of NOK 700,-- (EUR 86.60).

3. Reduced work preparation of press presetting:

Due to automatic job creation in Komori K-Station and Mitsubishi IPC Servers the preparation of signature data for the press workflow systems takes less time. For the first signatures preparation was reduced by 8 min. (4 min. customer data input plus 4 min. technical input for print job). For the following signatures preparation was reduced by 1 min. (no more manual overwrite of signatures). There are about 3.000 first and 22.500 following signatures per year.

With an hourly cost rate of the press operator of NOK 700,-- (EUR 86.80) per hour these savings sum up to EUR 45.136 for the relevant months in 2006 and to EUR 67.704 for the following years.

In additional to the 8 minutes savings for each first signature, job data is much more reliable today. The print operator no longer has to change all parameters manually, which naturally resulted in errors. Moreover, we have all historic information, and all machine settings for the reprints for each signature. It’s easier for the print operator with electronically scheduled jobs list - two clicks and the required information is immediately available.

AVOIDED COSTS (E)

1. Wage bill reduction invoice department (0.5 people)

Due to an optimized and more reliable feedback of data from production our invoicing is easier and faster today. The result: The invoicing department was reduced from 1.5 persons to 1 person. Simultaneously the time between delivery and invoicing was reduced. The effect is a higher liquidity. With an hourly cost rate of the according staff member of NOK 700,-- (EUR 86.80) the savings sum up to EUR 50.691,-- for the relevant time period in the first year (i.e. 8/12 of the 2nd year) and EUR 76.384,-- for each following year.

2. Wage bill reduction time sheets (0.5 people)

With the Shop Floor Data Collection at decentralized terminals a re-typing of time-sheets is no longer necessary. In result we now save half a person. With an hourly cost rate of the according staff member of NOK 700,-- (EUR 86.80) the savings are: (220 days per year x 8 hrs per day x EUR 86.80 x 0.5 Æ EUR 76.208,-- per year).

3. Reduction in paper waste

Reduction in paper waste for reprints:

As automation technology makes job preparation more reliable, we avoid 100 sheets of waste per reprint signature (which are 6.450 signatures for reprints per year).

Reduction in paper waste due to avoidance of wrong CIP3 assignment:

Due to automatic CIP3 assignment we today avoid formerly wrong manually CIP3 assignments (because of human error). This happened with approximately 5 out of 100. For every incident this meant approximately 500 sheets of waste. Today this is completely avoided.
The calculations are based on a paper price of EUR 90.-- per 100 kg. The avoided costs sum up to EUR 51,810.-- in the relevant time period of the first year after implementation (i.e. 8/12 of the 2nd year) and EUR 73,143.-- for each following year.

4. Avoided increase of scheduling time

After implementation of automation technology in April 2006 productivity was increased by 25%. At the same time there was still only one scheduler doing the production planning. This means that the scheduler was 25% more efficient due to automation technology. The calculation includes 220 working days per year, an hourly cost rate of NOK 700.-- (EUR 86.80) for the scheduler, and the increase of productivity of 20% (220 days/year x 8 hrs/day x EUR 86.8, -- x 0.2) in 2006 and 25% for the following years (220 days/year x 8 hrs/day x EUR 86.8, -- x 0.25). Cost savings sum up to EUR 30,554.-- in and EUR 38,192.-- for each following year.

5. Avoided increase of production meetings

The productivity increase of 25% was managed within the same time (30 minutes per day) and with the same 5 people involved into daily production meetings. Additionally, the meetings today include folding and stitching.

This means that PDC Tangen avoids an increase of costs for production meetings of 25%. With altogether 550 hours per year for production meetings (220 working days per year x 0.5 hrs x 5 people à EUR 86.60) the savings sum up to EUR 9,548.-- (EUR 47,740.-- x 0.2) for the relevant period in 2006 (9/12 of the 2nd year) and EUR 11,935.-- (EUR 47,740.-- x 0.25) for the following years.
ADDITIONAL EFFECTS

Automated order handling improved efficiency and productivity, as well as customer responsiveness a lot. Since implementation of process automation technology we won noticeably more customers than we did before. We are convinced that our advantage in combining new technology with our already implemented management information system has increased our ability to handle new types of customers.

The increase is clearly shown in the following table:

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2006</th>
<th>2007 (by mid-year)</th>
<th>Prognosis for 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>New customers</td>
<td>25</td>
<td>40</td>
<td>45</td>
<td>95</td>
</tr>
</tbody>
</table>

These numbers are not accounted for in the ROI calculation.

THE COSTS

One time costs (I)

Hiflex licenses are company-wide and include all modules on an unlimited number of workstations. Because of this model PDC Tangen already owned the license for Hiflex Scheduling, SFDC and JDF. Nevertheless the license costs for the required modules were proportionally calculated and taken into account as if an investment would have been necessary. The one time costs’ listing also includes hardware, training (Hiflex / Mitsubishi / Komori / Prinergy), installation, the Mitsubishi and the Komori licenses, Prinergy Synapse Link license, internal startup costs, training, and ancillary IT infrastructure costs.

Recurring costs (J)

The recurring costs comprise the proportional Hiflex recurring fee (for license and maintenance) for the Hiflex modules Scheduling, JDF and Shop Floor Data Collection as well as external services and internal IT maintenance.

THE CALCULATION OF THE RETURN ON INVESTMENT (ROI)
Best cost/benefit realization as a result of process automation implementation

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Wage bill reduction time sheets (0.5 person)</td>
<td>€ 76.208</td>
<td>€ 76.208</td>
<td>€ 76.208</td>
<td>€ 76.208</td>
</tr>
<tr>
<td>3. Reduction in paper waste</td>
<td>€ 51.810</td>
<td>€ 73.143</td>
<td>€ 73.143</td>
<td>€ 73.143</td>
</tr>
<tr>
<td>4. Avoided increase of scheduling time</td>
<td>€ 30.554</td>
<td>€ 38.192</td>
<td>€ 38.192</td>
<td>€ 38.192</td>
</tr>
<tr>
<td>5. Avoided increase of production meetings</td>
<td>€ 9.548</td>
<td>€ 11.935</td>
<td>€ 11.935</td>
<td>€ 11.935</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Annual benefits (C+D+E)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>€ 924.717</td>
<td>€ 1.319.842</td>
<td>€ 1.383.803</td>
<td>€ 1.443.116</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Cumulative benefits</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>€ 924.717</td>
<td>€ 2.244.559</td>
<td>€ 3.628.362</td>
<td>€ 5.071.478</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Discounted annual benefits = PV(F)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>€ 872.374</td>
<td>€ 1.174.655</td>
<td>€ 1.161.868</td>
<td>€ 1.143.083</td>
</tr>
</tbody>
</table>

### 3 - COSTS

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>One time costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>License Hiflex Scheduling, JDF and SFDC</td>
<td>€ 34.650</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Training Hiflex 4 days</td>
<td>€ 5.120</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Installation Hiflex 8 days</td>
<td>€ 8.192</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>40 Hiflex PDC Terminal Licenses</td>
<td>€ 14.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hardware for 40 Hiflex PDC Terminals</td>
<td>€ 20.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Hiflex Scheduling Terminal License</td>
<td>€ 500</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hardware for 1 Hiflex Scheduling PC</td>
<td>€ 1.500</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>JDF/JMF License Mitsubishi IPC II Server</td>
<td>€ 10.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mitsubishi IPC II Server (Hardware)</td>
<td>€ 1.500</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Training Mitsubishi IPC II Server (2 days)</td>
<td>€ 2.400</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>JDF/JMF License K-Station</td>
<td>€ 7.500</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>K-Station (Hardware)</td>
<td>€ 1.500</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Training K-Stations 2 days</td>
<td>€ 2.400</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>License Synapse Link</td>
<td>€ 16.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Training Prinergy and Synapse Link</td>
<td>€ 2.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>JDF/JMF License MBO</td>
<td>€ 5.300</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3x MBO Datamanager (Hardware)</td>
<td>€ 7.500</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Training MBO Datamanager (2 days)</td>
<td>€ 2.400</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Internal Startup-costs (1 month)</td>
<td>€ 15.624</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IT ancillary infrastructure costs</td>
<td>€ 10.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>Recurring costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hiflex recurring fee on license and maintenance</td>
<td>€ 17.325</td>
<td>€ 17.325</td>
<td>€ 17.325</td>
</tr>
<tr>
<td></td>
<td>External Services</td>
<td>€ 2.000</td>
<td>€ 2.000</td>
<td>€ 2.000</td>
</tr>
<tr>
<td></td>
<td>Internal IT maintenance (100h)</td>
<td>€ 8.680</td>
<td>€ 8.680</td>
<td>€ 8.680</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Annual costs = (I+J)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>€ 83.962</td>
<td>€ 96.929</td>
<td>€ 43.205</td>
<td>€ 28.005</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Cumulative costs</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>€ 83.962</td>
<td>€ 180.891</td>
<td>€ 224.096</td>
<td>€ 252.101</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Discounted annual costs = PV(K)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>€ 83.962</td>
<td>€ 91.442</td>
<td>€ 38.452</td>
<td>€ 23.514</td>
</tr>
</tbody>
</table>

### NET VALUE

<table>
<thead>
<tr>
<th></th>
<th>Annual net value = (F-K)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>-€ 83.962</td>
<td>€ 827.788</td>
<td>€ 1.276.637</td>
<td>€ 1.355.798</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Cumulative total</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>-€ 83.962</td>
<td>€ 743.826</td>
<td>€ 2.020.463</td>
<td>€ 3.376.261</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Discounted annual value = PV(N)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>-€ 83.962</td>
<td>€ 780.932</td>
<td>€ 1.136.202</td>
<td>€ 1.138.354</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>ROI per Year = F/K</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-100,0%</td>
<td>854,0%</td>
<td>2954,8%</td>
<td>4841,3%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>ROI Present Value = SUM(H)/SUM(M)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1847,2%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### NET PRESENT VALUE

<table>
<thead>
<tr>
<th></th>
<th>Net Present Value (SUM(P))</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>€ 5.180.906</td>
<td>US$ 7,131,880.25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### INTERNAL RATE OF RETURN

<table>
<thead>
<tr>
<th></th>
<th>IRR (Internal Rate of Return)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>969,7%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

International Print Production Award Application  Page 26 of 27
ABOUT PROJECT FINANCIAL ANALYSIS

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 EUR 100 and pays back EUR 150 after a short period of time has a 50% ROI. This is exactly how it is used in the financial analysis of PDC Tangen’s JDF project.

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 depending on the length of the period for the project financial analysis. The period which we have chosen for the financial analysis of PDC Tangen’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 investment's return relative to its cost and the lower the risk.