

# Competence of Human Capital for Digital Printing

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## Abstract

The introduction and integration of Digital Printing technology into the traditional Graphic Arts enterprises has brought about considerable changes into the printed media production, and workflow management. At the same time, the new technical possibilities and characteristics of the digitally printed documents require the development of new marketing strategies for the thorough information of the customers.

One important aspect within Digital Printing Production concerning its further development is the competence and skills that are required from the Human capital in order to gain the highest possible added value from the establishment and application of this new printing technology. Aim of this paper is to explore the competence of the human capital for Digital Printing Production in the main areas described below:

- Qualifications and skills for digital printing technology (machine operator level)
- Integration within the traditional Graphic Arts working environment and production work flow
- Managing and marketing digitally printed documents into the printed media market

Within these areas, are examined the skills and knowledge that are required by the human capital for the efficient employment with in digital printing production.

Within the paper it is also discussed the importance of the Graphic Arts qualifications and their combination with other new skills that are necessary for the human capital that is employed into the digital printing production.

## Introduction

Digital Printing has developed rapidly since it was first introduced into Graphic Arts production during the last decade and has brought about significant changes, not only in printing itself but also in the production workflow and the media market. According to the forecast "Future of Print" [PIRA 2000], digital printing will gain ground from traditional printing processes and it is estimated that by the year 2010 it will enjoy a market share of 20%. Furthermore, digital printing increases by 30% every year. These indicators show very clearly that Digital Printing is becoming one of the main printing processes within printed media production.

Among the most important factors within Digital Printing Production are the competence and skills of the Human capital that is currently employed or will be employed in the near future.

The main problem identified here for Graphic Arts enterprises is how it will be possible for their existing personnel with traditional qualifications to be efficiently integrated in the new working environment and workflow production. Another important aspect is the possibility of finding new qualified personnel for digital printing.

The main objective of the research is to identify the competence characteristics of the human capital that is required for digital printing production on both the technical and management level as described below:

- Qualifications and skills for digital printing technology (machine operator level)
- Management of digital printing production both internally and in the printed media market.

A key issue within the research is the context of the competence that has to be performed by human capital concerning digital printing, as well as the extent of knowledge and skills that have to be derived from fields related to Graphic Arts technology.

Furthermore, the issue of the degree of importance of traditional Graphic Arts qualifications for the digital printing working environment and production will be discussed. The identification of the human capital competence characteristics will accommodate the establishment of more accurate measures for the adaptability of the existing personnel and the implementation of effective training and education actions, suitable to the nature and the specific requirements of this field of the Printed media sector.

## Research Methodology

The research methodology was based on:

- Literature study.
- Case studies.

## Literature Study

It was relative difficult to gain information from scientific areas concerning the field of digital printing. Therefore, research on this field was based mainly on industry studies and analysis and on scientific papers related to the digital production workflow for Media Production [EGF 1998], [COMPRINT 1998], [NRW 2000], [DEMAND 2001], [GATF 2000], [FRAUNHOFER 1999]. Furthermore, literature study has

been carried out on human resources management and development [GORANZON 1988], [WALTON 1999],[ KOENIG 1999], [COMES 2000], [VSW 1998]. Literature research has been combined with case studies research in order to extract the research results.

**Case Studies**

The objective of the case studies was to identify the key issues concerning the competence requirements of human capital for enterprises where digital printing machines/systems have been installed. The studies were carried out between January and February 2001. Information was collected on the basis of questionnaires and interviews among digital printing enterprises in Sweden and Greece. The criterion for the selection of the enterprises was the installation of a digital printing machine or system. Four interviews took place: one in Sweden, with the Digital printing network representatives of Grafiska (the employers' federation of the Swedish printing industry) and three in Greece. A questionnaire was developed and distributed to 8 Swedish and 4 Greek digital printing enterprises during this time. 6 questionnaires were answered, 2 from Sweden and 4 from Greece (50% out of a total of 12 distributed questionnaires).

Due to the very limited time of the survey, the questionnaires were analysed only in the general direction of the answers concerning the main groups of questions which covered the following subjects: General information on the enterprises, information on the type of digital printing machines installed, implications of the installation of the digital printing machine/system in the enterprise, information concerning human capital competence, education and evaluation and the determination of the different qualifications required for digital printing.

The results of the survey were analysed and combined with the literature research in order to obtain more accurate conclusions.

**Digital Printing – Definitions**

Digital printing was born early in the last decade. In the years that followed, digital printing became the most significant technology for printed media production (SEYBOLD 1998). The term is used today to describe the systems and equipment that print sheets or rolls of paper on one or both sides, using different imaging technologies with one or more colours. Furthermore, the term «digital printing» is used to define the printing-imaging processes where film and/or plate making processes are eliminated and where printing or imaging takes place immediately after the pre-press production process. Digital Printing, whatever the technology employed, is considered to span the gap between desktop computer printing and «traditional printing». In so doing, it consumerizes the printing process, shifting the emphasis from output to content [PRE-PRESS 1999].

Garyl Holland describes the different types of Digital Printing machines as follows [HOLLAND 2001]:  
 Non-variable on-press direct imaging (No film or plate)  
 True digital which can handle variable content (Image carrier is re-imaged after each print).

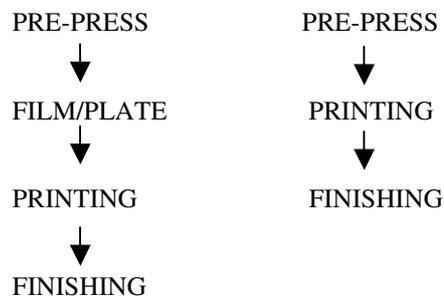
For the research, the following are considered as digital printing:

- Stand-alone machines either for one- or four-colour printing in terms of capacity compared to offset printing (not copiers), producing sheets or rolls of paper, with further processing in a binding and finishing department.
- Digital printing systems where printing units or machines are combined with on-line binding and finishing systems, leading to a ready-to-deliver printed document. (Trimming can either be included or be a separate unit to these systems).
- Direct imaging printing machines

**Digital Printing - Workflow**

In comparison with traditional printing processes, Digital Printing can be presented as in diagram 1 below:

**TRADITIONAL DIGITAL**



*Diagram 1. Digital versus Traditional Printing*

The installation of a new technology mostly based on electronic/digital systems causes a number of changes in the entire environment of a enterprise. In particular, Traditional Graphic Arts enterprises have faced changes not only internally but also in their external relationships.

These changes can be briefly described as follows:

Internal changes: Working environment  
 Production workflow  
 Art of employment  
 Differentiation of employees tasks.

External changes: Changes in the printed media market  
 Customer-oriented marketing strategy  
 Movement towards communication  
 service provider oriented activity

These internal and external changes are very clearly determined in a traditional Graphic Arts enterprise after the installation of a digital printing machine or system. The former orientation of the enterprise with regard to its traditional production process determines the degree of the changes that occur internally and externally.

Managing production workflow means executing the production process by means of the defined activities, using the available resources and the specified set of input objects. But this is not enough. The objective of production management (or workflow management), is

doing the job as well as possible [ENLUND 1999]. This statement describes quite clearly the need for the total integration of a digital printing machine/system in the production, management and marketing activities of the enterprise.

The research has revealed that internal and external changes are both equally important. And this is so because all Traditional Graphic Arts enterprises leave the simple manufacturing environment and become «service providers» for their customers, by pursuing customer-oriented sales and marketing strategies. The installation of digital printing machines/systems requires certain modifications to the production workflow of a traditional Graphic Arts enterprise.

Relatively fewer modifications are required for the workflow production after the installation of direct imaging and/or stand-alone printing machines. These machines operate like the traditional offset printing machines and are integrated without any difficulties into the production workflow.

More significant are the required modifications to the production workflow of digital printing machines or systems such as Indigo or XEIKON, with on-line finishing systems. The most important elements of the workflow modifications are the structure of the digital files that are transferred from the pre-press to the printing machine / system and the establishment of the Job Ticket Format (JTF) concept, for the management of printing (Job management, Imposition, Finishing).

### Digital Printing, Re- Engineering and the Printed Media Market

The integration of a digital printing machine/system into a traditional Graphic Arts enterprise must not be considered as a simple installation in the enterprise environment. Instead, it requires a business re-engineering process [HAMMER 1990]. Hammer proposed a system which is designed to achieve business efficiency and customer service, through the re-organisation of the holistic activities of an enterprise. According to Hammer, the key internal benefits for the enterprise are:

- Stronger alignment of core processes to business strategy.
- The creation of customer value becomes a driver for all activities of the enterprise.
- Benchmarking is used to accelerate learning and provide a stimulus for change.
- Enhanced capability and performance lead to increased ambition and conviction.

These benefits seem to be implemented only by the development of the human capital that participates in the re-engineering process. Within this more generic approach, it is necessary to define the human capital competence for the digital print working environment.

Digital Printing has become established in the market with an added value based on certain advantages and characteristics that are important for a rapidly changing environment in printed media. Some of these characteristics are:

- Short cut production times
- Fast delivery

- Printing on Demand
- Personalisation

In a customer-oriented marketing strategy, the installation of any new technology is not the main issue, but a clear benefit with regard to customer needs, where this new technology is increasing services to the customer. An interesting argument at this point is that the installation of a digital printing system can also push the company to change its behaviour both internally and in its relationship with customers. In some cases, digital printing can act as an agent of structural changes in organization and management. This behaviour is found in enterprises where digital printing was seen as a complement offering customers new possibilities, rather than an alternative to lithographic printing [PIRA 2000].

Helene Juhola and Asta Back suggest that good customer contact systems are needed to really profit from the new production chains made by digital printing [JUHOLA 98]. Another influential aspect is the rapid transformation of the entire environment for the traditional Graphic Arts companies. Changes in media markets and products are very fast, whereas the traditional Graphic Arts enterprises are still working with the traditional manufacturing-oriented structure and pace [ROSENQUIST 2000].

As Professor Nils Enlund states: “ The main impact of new technology comes through the consumer market - needs and attitudes are changing. Within media companies, technological change has greater impact on organisation than on production tasks” [ENLUND 2000]. The digital printing systems and machines would never have been widely accepted if they had been limited only to the printing of loose sheets of paper. As systems that PRINT on PAPER, they have to implement the main role of a printed document: To look and function exactly as the traditionally printed and finished documents and products [XML 2000]. This task can only be satisfactorily fulfilled if human capital is capable of working efficiently in this working environment. This aspect of digital printing is one of the most important for the successful establishment of digital printing systems.

### Human Resources/ Capital Development

The term “Human Resources Development” has been gradually developed by the transformation of Human Resources Management [BEER 1984], [WALTON 1999]. Other concepts and research fields related with human capital development are the Interorganizational Relationship (IOR) [WOOTHUIS 1999] and Emotional Intelligence (EI) [MOELLER 2000].

Walton has suggested the following compass for human resources that is presented below in diagram 2:

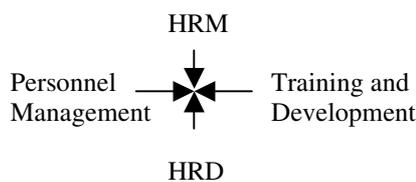


Diagram 2. The human resource compass:(Walton 1999)

Politis has suggested another context model for the Human Resources Strategy with the integration of all new elements concerning Human Capital Development [POLITIS 2000].

This strategy is presented in Diagram 3 below, following the modification of the Human Resources Compass proposed by Walton:

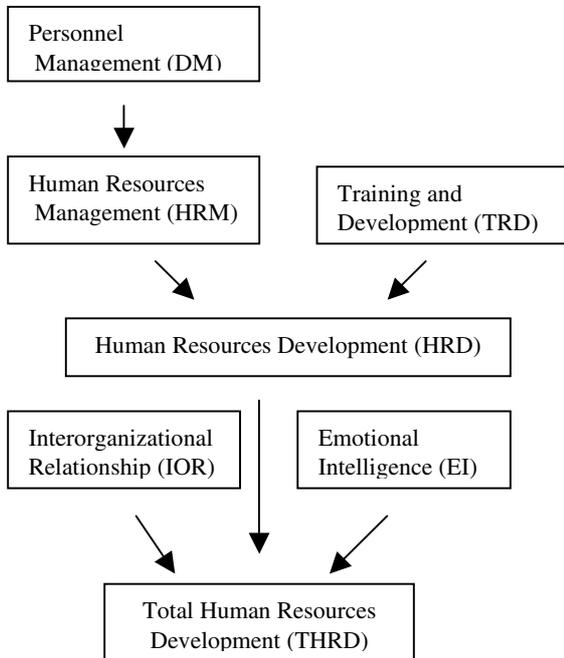


Diagram 3. A model for Total Human Capital Development (THCD)

According to this approach, the development and improvement of human capital competence is a part of a range of actions aimed at the application of a holistic Human Capital Development strategy.

### Human Capital Competence For Digital Printing

Human capital covers all individual capabilities, the knowledge, skill and experience of the enterprise's employees. However, human capital is more than the sum of these dimensions. It includes the dynamics of an intelligent organisation in the turbulent environment. Human capital also includes the creativity and innovativeness of the organisation [JALONEN1998].

An interesting aspect that is common today within digital printing production is the discussion whether digital print operators must be qualified or not. Machine/system suppliers argue that operators of digital printing machines do not need to be qualified. This argument is used as one of the advantages of digital printing, in direct comparison with other printing processes, and in particular lithographic printing and the skills that are required to operate such a machine.

However, this approach seems to be changing, as far as the supplier's side is concerned. Nickolas Lok, for example, from Indigo UK, states that the main digital printing operator should understand print quality and colour. He/She also should have a good knowledge of

Macintosh/PC and the related software applications together with extensive experience with Postscript and PDF. Maintenance and adjustments of the digital printing press are also essential [BPIF 2000].

Again, research among digital printing enterprises has shown differences in certain skills and knowledge which are considered important for them. In most cases, printing skills and machine maintenance are considered important but some other respondents do not consider this expertise to be of the same importance, whereas data files and formats and imposition are considered very important by all interviewed enterprises.

According to a study published by the Board for Education in Media and Information (GRAFISKA - The Swedish Printing Industry Federation), on the question of which competence Graphic Arts Companies would like to develop, among 20 different areas, the greatest percentage was given to the «development of their own product» and «general computing». If «computing adapted to graphic arts» is put together with «general computing» it definitely becomes the largest area [GRAFISKA 1999].

Another study published by the British Printing Industries Federation has shown that the digital printing owner / manager should have four main types of skills in order to be able to run a digital printing business [BPIF 2000]:

- Pre-press skills (Handling prepress files and formats, Postscript and PDF files)
- Machine operating skills
- Sales and customer service skills
- Management skills

The survey among the Swedish and Greek enterprises revealed that in general Graphic Arts skills and expertise are considered very important for the successful installation of a digital printing machine/system. But this competence must be implemented with knowledge in new areas from the different areas of Graphic Arts and computer science. Depending on the human capital core task orientation, this expertise can be determined below, following the results of the survey among the enterprises where a digital printing system has been installed.

1. For the machine operator (digital printer) level:
  - Printing processes knowledge
  - Computer skills
  - Machine maintenance skills
  - Colour/colour management knowledge
  - Digital workflow knowledge (formats and systems such as PDF, Job Ticket Format and Ripping)
  - Imposition knowledge
  - Binding and Finishing knowledge
2. For the management level both regarding production workflow (Internal management tasks) and customer service (external management tasks).
  - Graphic Arts knowledge
  - Sales/marketing knowledge
  - Computer skills
  - Customer relationship management
  - Digital workflow production (systems, files, formats)

## Conclusions

Digital Print creates a number of special requirements and tasks for human capital: including Knowledge of the technical capabilities of the digital printing machine / system

- The ability to explain to the customers the added value of digitally printed documents
- Understanding the customers and their needs and providing the most suitable solution covered by Printed Media
- Efficient management capabilities and administration of a large number of small jobs with very short turnaround times, tight deadlines and fast delivery

Graphic Arts expertise, knowledge, experience and skills are important for digital printing production environments but they have to be implemented with an extensive range of new skills which are required today. These skills are categorised as: general computer knowledge, pre-press (colour and colour management, data files and formats), digital workflow production, databases and management skills.

The human capital employed in an enterprise with a digital printing system should:

- Be able to work within a flexible – cooperative working environment (teamwork) with continuously changing tasks
- Be capable of working within a complex management environment where technology, administration, production workflow and customer satisfaction issues are combined
- Be ready to participate to life-long learning concepts

Human capital with expertise in Graphic Arts and Media both at the technical and the management level need to develop themselves not only by keeping and importing their traditional competence but also by entering the so-called knowledge society and becoming the leading class within it. This development will be based to a new set of management elements which include a high degree of interactivity, cultivation of differences, and freedom of action [QUINN 1997] as well as a strong emphasis on individual recognition [KANTER 1989]. These new elements need not to be ignored at any new Human Capital Development Strategy.

## Further Research

Further extensive research is required in the fields of the adaptation of the educational and training systems in such a way that the competence development of human capital is sufficiently supported. The survey revealed weak points in the formation of the national education and training systems especially in Southern Europe (Greece). Another important issue that has been extracted from the research was the different perception and integration of digital printing systems that are installed in enterprises with different orientation and core business, concerning human capital and their demand for competence development. In particular, research has to be done in order to identify the different approaches to human capital competence among

the different types of Graphic Arts and media enterprises that are entering digital printing production.

## Acknowledgments

I would like to thank Mr Hans Danielson and Mr Hans Johansson from Grafiska Företagens Förbund (the Swedish printing Industry Federation), as well as Drs Gerrit Roseboom from Dienstencentrum–KVGO (The Royal Dutch Association of Printing and Allied Industries) for their valuable help.

I would like also to thank all Graphic Arts enterprises from Greece and Sweden for their contribution and time they spared for this research.

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