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POST GRADUATE STUDIES – SECOND CYCLE

THESIS:

ERP SYSTEMS: ADAPTING INFORMATION SYSTEMS AND WAYS TO IMPROVE PROCESSES IN THE PRINTING INDUSTRY IN MACEDONIA

CANDIDATE:

MIHAJLO NAUMOVSKI

MENTOR:

ASSOC. PROF. DR. ADRIAN BESIMI

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Abstract

They say the only way we grow is when we make a change. Not only as individuals, but also change in the business makes a difference that could increase competitively in your industry. But change means going into an area of unknown challenges, which is mostly uncomfortable for many. Especially lack of knowledge and expertise could increase discomfort.

Implementing ERP system, especially in small countries like Macedonia and in such fragile industry like the printing industry, can be quite a change and a challenge. In this research we found very few companies ready to implement ERP system. Most of them only a few modules of such system. The lack of knowledge, expertise and mostly resources (financial and educated stuff) takes companies further away from taking that leap and making that change.

Elaboration of the printing industry in Macedonia provides details of the issues that companies face due to political influence, corruption and lack of system and the advantages the have competing on international market. Information of the influence of the printing industry in the country's economy is presented and other statistics that gives the big picture to the reader.

Case studies produce well comparison of the implementation of ERP systems in different countries, as well as in Macedonia.

I conclude with confirmation of my second hypothesis that undereducated staff in the printing companies present an issue in implementing ERP system and working with it. But also partly confirming my first hypothesis that very few of the printing companies in Macedonia are able to implement ERP system or modules of it. And it does improve business processes in their companies.

Абстракт

Викаат единствениот начин за да растеме е да направиме промена. И не само како индивидуи, промената во бизнисот може да ја зголеми компетитивноста во индустријата во која работиме. Но, промената значи влегување во поле на непознати предизвици, што може да биде некомфорно за многу. Особено незнаење и нестручност може да ја зголеми неугодноста.

Имплементирање на ERP систем, особено во мала земја како Македонија и во осетлива идустрија како што е печатарската, може да биде значително предизвикувачки. Во ова истражување најдов многу малку компании подготвени да имплементираат ERP систем. Повеќето имплементираат само неколку модули од системот. Ниското ниво на знаење, стручност и слабите ресурси (финансиски и едуцирани вработени) ги одалечува компаниите од превземање таков чекор и правење на таква промена.

Елаборација на печатарската индустрија во Македонија дава детали од проблемите со кои компаниите се соочуваат поради политичкото влијание, корупцијата и немањето на систем како и предностите на работењето на интернационални пазари. Презентирани се информации како влијанието на печатарската индустрија во Македонската економија и други статистички податоци кои ја даваат поголемата слика на читателот.

Студии на случаи даваат добра споредба на имплементацијата на ERP системи во разни земји како и во Македонија.

Завршувам со заклучок дека е потврдена мојата втора хипотеза дека ниското ниво на едукација на вработените во печатниците претставуваат проблем за имплементација на ERP систем и за работа со него. Но, исто така делумно се потврдува мојата прва хипотеза дека многу малку печатници во Македонија можат да имплементираат ERP систем или само модули од него. А успеваат да ги подобрат бизнис процесите во компаниите користејќи таков систем.

1. Introduction of Information Systems and ERP Systems

1.1 Introduction of Information System (IS)

An **information system (IS**) (Information system, 2019) is an organized system for the collection, organization, storage and communication of information. More specifically, it is the study of complementary networks that people and organizations use to collect, filter, process, create and distribute data.

"An information system (IS) is a group of components that interact to produce information."

A computer information system is a system composed of people and computers that processes or interprets information. The term is also sometimes used in more restricted senses to refer to only the software used to run a computerized database or to refer to only a computer system.

Information Systems is an academic study of systems with a specific reference to information and the complementary networks of hardware and software that people and organizations use to collect, filter, process, create and also distribute data. An emphasis is placed on an information system having a definitive boundary, users, processors, storage, inputs, outputs and the aforementioned communication networks.

Any specific information system aims to support operations, management and decision-making. An information system is the information and communication technology (ICT) that an organization uses, and also the way in which people interact with this technology in support of business processes.

There are various types of information systems, for example: transaction processing systems, decision support systems, knowledge management systems, learning management systems, database management systems, and office information systems. Critical to most

information systems are information technologies, which are typically designed to enable humans to perform tasks for which the human brain is not well suited, such as: handling large amounts of information, performing complex calculations, and controlling many simultaneous processes.

The six components that must come together in order to produce an information system are:

1) Hardware: The term hardware refers to machinery. This category includes the computer itself, which is often referred to as the central processing unit (CPU), and all of its support equipment. Among the support, equipment are input and output devices, storage devices and communications devices.
2) Software: The term software refers to computer programs and the manuals (if any) that support them. Computer programs are machine-readable instructions that direct the circuitry within the hardware parts of the system to function in ways that produce useful information from data. Programs are generally stored on some input/output medium, often a disk or tape.
3) Data: Data are facts that are used by programs to produce useful information. Like programs, data are generally stored in machine-readable form on disk or tape until the computer needs them.
4) Procedures: Procedures are the policies that govern the operation of a computer system. "Procedures are to people what software is to hardware" is a common analogy that is used to illustrate the role of procedures in a system.
5) People: Every system needs people if it is to be useful. Often the most overlooked element of the system are the people, probably the component that most influence the success or failure of information systems. This includes "not only the users, but those who operate and service the computers, those who maintain the data, and those who support the network of computers." <Kroenke, D. M. (2015). MIS Essentials. Pearson Education>

6) Feedback: it is another component of the IS, that defines that an IS may be provided with a feedback (Although this component isn't necessary to function).

Data is the bridge between hardware and people. This means that the data we collect is only data until we involve people. At that point, data is now information.

1.2 Types of information system

The "classic" view of Information systems found in the textbooks in the 1980s was a pyramid of systems that reflected the hierarchy of the organization, usually transaction processing systems at the bottom of the pyramid, followed by management information systems, decision support systems, and ending with executive information systems at the top. Although the pyramid model remains useful since it was first formulated a number of new technologies have been developed and new categories of information systems have emerged, some of which no longer fit easily into the original pyramid model.

Some examples of such systems are:

- data warehouses
- enterprise resource planning
- enterprise systems
- expert systems
- search engines
- geographic information system
- global information system
- office automation.

Several IS scholars have debated the nature and foundations of Information Systems which have its roots in other reference disciplines such as Computer Science, Engineering, Mathematics, Management Science, Cybernetics, and others. Information systems also can be defined as a collection of hardware, software, data, people and procedures that work together to produce quality information.

1.3 Introduction of Enterprise Resource Planning (ERP) Systems

Enterprise resource planning (ERP) (Enterprise resource planning, 2019) is the integrated management of core business processes, often in real-time and mediated by software and technology. These business activities can include:

- product planning, purchase
- production planning
- manufacturing or service delivery
- marketing and sales
- materials management
- inventory management
- shipping and payment
- finance

The term ERP was coined in 1990 by Gartner1 (WHAT IS ERP?, n.d.), but its roots date to the 1960s. Back then, the concept applied to inventory management and control in the manufacturing sector. Software engineers created programs to monitor inventory, reconcile balances, and report on status. By the 1970s, this had evolved into Material Requirements Planning (MRP) systems for scheduling production processes.

In the 1980s, MRP grew to encompass more manufacturing processes, prompting many to call it MRP-II or Manufacturing Resource Planning. By 1990, these systems had expanded beyond inventory control and other operational processes to other back-office functions like accounting and human resources, setting the stage for ERP as we've come to know it.

`Today, ERP has expanded to encompass business intelligence (BI) while also handling "front-office" functions such as sales force automation (SFA), marketing automation and ecommerce. With these product advancements and the success stories coming out of these

systems, companies in a broad range of industries—from wholesale distribution to ecommerce—use ERP solutions.

Moreover, even though the "e" in ERP stands for "enterprise," high-growth and mid-size companies are now rapidly adopting ERP systems. Software-as-a-Service (SaaS) solutions—also referred to as "cloud computing"—have helped fuel this growth. Cloud-based solutions not only make ERP software more affordable, they also make these systems easier to implement and manage. Perhaps even more importantly, cloud ERP enables real-time reporting and BI, making them even valuable to executives and staff seeking visibility into the business.

As a result, companies of all sizes and a wide range of industries are transitioning to cloud ERP systems. In fact, Forrester predicts that SaaS-based ERP adoption will rise 21 percent annually through 2015. When you stop to consider the benefits of ERP, it's easy to see why it's become so popular and why its use will continue to grow so rapidly.

1.4 The Business Value of ERP

At its core, ERP helps employees do their jobs more efficiently by breaking down barriers between business units. More specifically, an ERP solution:

- Gives a global, real-time view of data that can enable companies to address concerns proactively and drive improvements
- Improves financial compliance with regulatory standards and reduces risk
- Automates core business operations such as lead-to-cash, order-to-fulfillment, and procure-to-pay processes
- Enhances customer service by providing one source for billing and relationship tracking.

When you add up these advantages, the value of ERP—particularly cloud ERP—is clear. With an ERP solution, employees have access to accurate information that enables them to make better decisions faster. Not only that, but ERP software helps to eliminate redundant processes and systems, dramatically lowering the cost of doing business overall.

1.5 The Business Value of ERP

That is the question many business leaders ask themselves (To ERP or Not to ERP: Should SMB's Invest In Enterprise Resource Planning?, 2017). Acquiring an ERP system is one of the biggest investments a business can make, yet many small and young businesses claim they are 'too small' for ERP. This stems from the mindset that the number of users drives the need for an ERP solution.

The truth is, a small business must be faster and sharper than the competition. In today's business landscape, no business is too small for an ERP solution. ERP allows small businesses to appear, act and operate like an enterprise-scale business.

Within a small company or startup, employees wear multiple hats. Everyone pitches in wherever and whenever the need arises (which is frequently). Who has the time to manually process multiple spreadsheets and separate mountains of data? ERP systems geared towards small businesses are able to blend and automate key business functions such as order processing, production and finances.

1.6 What Benefits Do Small Businesses Get From ERP?

Transparency: Instead of each department having its own information system, all relevant data can be shared and accessed by all the departments. This eliminates the need to re-enter or export data, which can result in less errors, increased productivity and reduced expenses on human resource.

Decision-making: Real-time data provided by the system can be beneficial for marketing, management, accounting, and enables the organization to make vital decisions on time and reduce waste. Teams can detect any potential obstacles or issues that may shake productivity

levels. An overall picture of operations allows for business leaders to make effective decisions and respond quickly to a changing business environment.

Productivity: With increased clarity by streamlined business processes, staff can shift their focus on managing increased volumes of business. This aids in transforming various facets of your business and overcoming the challenges involved in business growth.

1.7 What are signs that your business needs an ERP?

The majority of small businesses start with just the basics. This may include a combination of simple accounting software and document-based processes—i.e., spreadsheets, synced documents.

As the business expands and transactions increase, it may become more time-consuming and difficult to process a larger volume of data. Business processes become much more tedious, such as; inputting sales and purchase orders from various clients, updating inventory, manual stock checks, processing invoices, billing and keeping track of client interactions.

This is especially true if this information is stored in separate systems and databases. This means that data may need to be imported/exported from program to program in the workflow, allowing room for errors.

ERP can automate these manual processes, allocating more company time to sales and business development instead of administrative tasks. Furthermore, ERP software allows synchronous workflow from inquiry to invoice and payment. The ideal ERP system would handle the processes in one fluid system:

Contact with Client (CRM) → Order Processing (Supply and Inventory Management) → Invoicing and Payment (Finances and Accounting)

1.8 What Does ERP Do For My Business?

An ERP creates a framework by which your business can plan its resources, as the name implies (Why Implement an ERP?, n.d.). What resources? Everything from inventory to accounts receivable, to your entire accounting infrastructure can be managed by an ERP. Depending on what you choose, it may also come with a highly-competent customer relationship management (CRM) platform.

A conversation has been made with the Senior Sales Engineer at Acumatica (a company that offers ERP for small and medium sized businesses) Douglas Johnson, about which benefits such solution would bring to a small business. He pointed out the following:

- Your invoices and reports will not only look more professional, but they will also comply with each client's preference, which is great if you're running a B2B company.
- Likewise, your financial documents will also comply with Generally Accepted Accounting Principles (US GAAP) and International Financial Reporting Standards (IFRS). In essence, it keeps auditors at bay and prevents any mishaps from occurring due to an ambiguously-formatted document.
- ERP software will also manage your inventory, time sheets, and expense reports. In addition to this, some of them also include a cool CRM that manages the front end of your business' activity.
- A good ERP software for small business will streamline most of your operations so you can worry strictly about the business end of the business. Isn't that what you wanted to do when you started the whole thing? Some integrate seamlessly into your company so that you and your employees do not waste too much time trying to work out the kinks.
- With ERP, you respond much more quickly to changes in the market and make smarter decisions. You also consolidate accounting in a way that makes it easier to spot mistakes that may lead you to pay for something you did not receive from a vendor.

In essence, ERP is a platform that manages a company's entire financial and workflow ecosystems.

1.9 SaaS vs On premise vs Desktop applications

SaaS stands for **Software as a Service** (SaaS vs On Premise vs Desktop Applications, 2012). It means that a user typically logs into a website that houses the software for digital signage content creation, user administration, and media player management.

The content such as images and videos are all located in the cloud which is a fancy way of saying they are on someone else's servers.

The SaaS model is usually priced as a monthly or annual fee which covers hosting/ bandwidth costs, maintenance, support, and development.

The upside to a SaaS Solution is that the customer is essentially outsourcing their IT Department. The customer has no need to maintain a Digital Signage Server. Instead they are essentially renting space on a server hosted by a 3rd party. For some customers this is also valuable in that SaaS is an operating expense as opposed to a capital expense. This allows the custom to immediately expense that cost instead of capitalizing the cost and writing it off over a period of years.

FIGURE 1:GRAPHIC REPRESENTATION OF SAAS AND ON-PREMISE

An **On Premise** Server is a Web Based Solution like SaaS however instead of the customer logging into a web portal, the custom logs into a local server that they maintain. The

upside here is that a customer knows up front what their total cost will be as they are doing their own hosting. It is more expensive up front, however there is no ongoing fees. They are responsible however for maintaining and managing that server.

A **Desktop Application** works like any other program that you are familiar with such as MS Word or PowerPoint. The application is loaded onto a PC and launched from the desktop. The user creates their content locally on their PC before sending it to the player. The upside here is that the customer knows their total cost up front. It is also a familiar environment to work in. Desktop Applications are solid and have been around for a long time. They are not however as flexible as a Web Based Solution which by design make it much easier for multiple people to collaborate on the same project from multiple locations.

1.9.1 Advantages of SaaS

1. Reduced time to benefit

Different from the traditional model, in SaaS the software (application) is already installed and configured (15 Key Considerations: SaaS vs On-Premises Software, 2014). The user has the advantage of provisioning the server for an instance in the cloud and in a couple hours they can have the application ready for use. This reduces the time spent in installation and configuration, and can reduce the issues that can get in the way of the software deployment.

2. Lower costs

SaaS has a differential regarding costs since it usually resides in a shared or multitenant environment where the hardware and software license costs are low compared with the traditional model.

Another advantage is that the customer base can be increased since it allows small and medium businesses (SMB) to use a software that otherwise they would not use due to the high cost of license.

Maintenance costs are reduced as well, since the SaaS provider owns the environment and it is split among all customers that use that solution.

3. Scalability and integration

Usually, SaaS solutions reside in cloud environments that are scalable and have integration with other SaaS offerings. Comparing with the traditional model, users do not have to buy another server or software. They only need to enable a new SaaS offering and, in terms of server capacity planning, the SaaS provider will own that.

4. New releases (upgrades)

SaaS providers upgrade the solution and it becomes available for their customers. Costs and effort associated with upgrades and new releases are lower than the traditional model that usually forces the user to buy an upgrade package and install it, or pay for specialized services to get the environment upgraded.

5. Easy to use and perform proof of concepts

SaaS offerings are easy to use since they already come with best practices and samples inside it. Users can do proof of concepts and test the software functionality or a new release feature in advance. Also, they can have more than one instance with different versions and do a smooth migration. Even for large environments, users can use SaaS offerings to test the software before buy it.

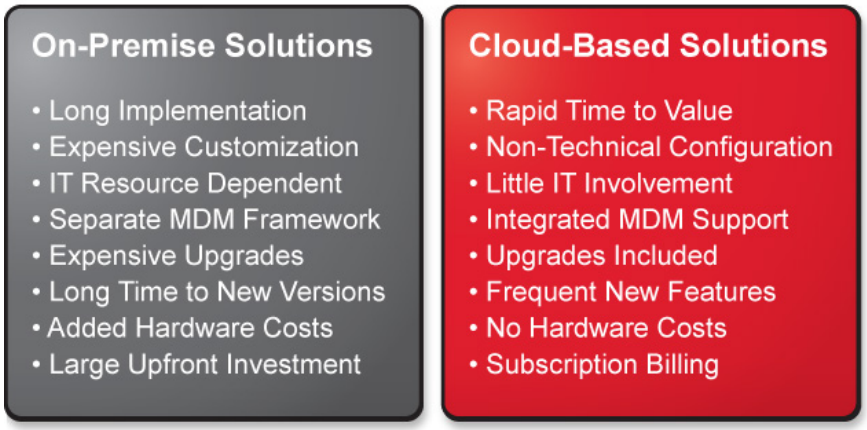

FIGURE 2: SAAS VS ON-PREMISE

1.9.2 How to decide between SaaS and On-premise applications

1. Focus = Success: Cloud deployments permit venture groups to concentrate less on framework and application conveyance. Execution groups can rather concentrate on business needs and give understanding into the information, which is a part of big business usage that is again and again scammed in a crunched venture.

In the event that your organization has a develop IT group who have a background marked by fruitful administration conveyance, at that point an on-premises deployment may permit you approach center and along these lines an equivalent capacity to succeed. Check your association and its administration conveyance development to guarantee your group can concentrate on conveying business esteem and won't get diverted foundation and application conveyance.

2. Previous adoption of cloud: In my experience, organizations who are past adopters of cloud-based SaaS solutions are significantly more prone to pick cloud-based deployments in their future projects. What is your organization's history of cloud adoption? How big would the impact be in the event that you picked a cloud deployment or just followed in the way of past internal cloud adopters?

3. Integration: Integration contemplations can frequently impact the deployment strategy. Regularly this is on the grounds that confusions around coordination multifaceted nature in the cloud can direct organizations from attempting. Frankly, flexible integration choices exist with most SaaS products to help both a wide assortment of sources and availability techniques.

Most organizations have numerous administrative and security commitments when transmitting information outside their system. Wind up proficient about the information sources your undertaking will require and comprehend the risk profile for that information along and your organization's information security necessities. Cloud sellers run very secure tasks and frequently have SSAE 16 (SAS 70) or comparable review controls to guarantee your information is ensured. Being proficient about the information prerequisites for your ventures is imperative for both on-premises and cloud deployments. Utilize this information to help guide stakeholders to settle on the clever decision for the association dependent on certainties, not on misguided judgments on information combination or security challenges.

4. Time to value: Cloud-based organizations decrease the general usage time of tasks, enabling the business to acknowledge an incentive from the venture sooner than conventional on-premises deployments. Since most of SaaS environments are provisioned by the merchant soon after the agreement marking, normal IT lead time is removed and the project team can start implementing immediately. On-going administration and tasks of the cloud environments are an obligation of the seller. SaaS sellers have committed cloud operations teams prepared to help on client demands and regularly self-service tools exist for routine procedures. This streamlined conveyance is frequently unique to cloud/SaaS organizations, except if obviously your inside IT group has a very mature service delivery process. On the off chance that your venture is under a tight timetable, at that point cloud-based deployments ought to be a noteworthy thought. Assuming, in any case, other gating factors are managing your execution cycles, on-premises deployment may enable your organization to understand an equivalent time-to-value benefit.

5. Flexible payment options: Many factors in your organization's financial circumstance can influence the choices made about software applications buys. With consistently fixing IT spending plans, lower up-front expenses are frequently a thought for the purchasing organization. In the event that this is your circumstance, a cloud-based SaaS solution and its subscription-based payment method is the option for you. Search for merchants that offer adaptable payment options for SaaS solutions. Most sellers, can provide you with choices to month to month, quarterly or yearly payment SaaS charges. There are additionally situations when CAPEX cost is preferred to secure yearly spending plan (in these conditions obtaining licenses in advance can be advantageous). A few merchants enable you to buy customary on-premises licenses and sign-up for SaaS conveyance of your licenses through a bring-your-own-permit approach. Search for a merchant who is anything but difficult to work with and offers a payment option that addresses the issues of your business both today and later on.

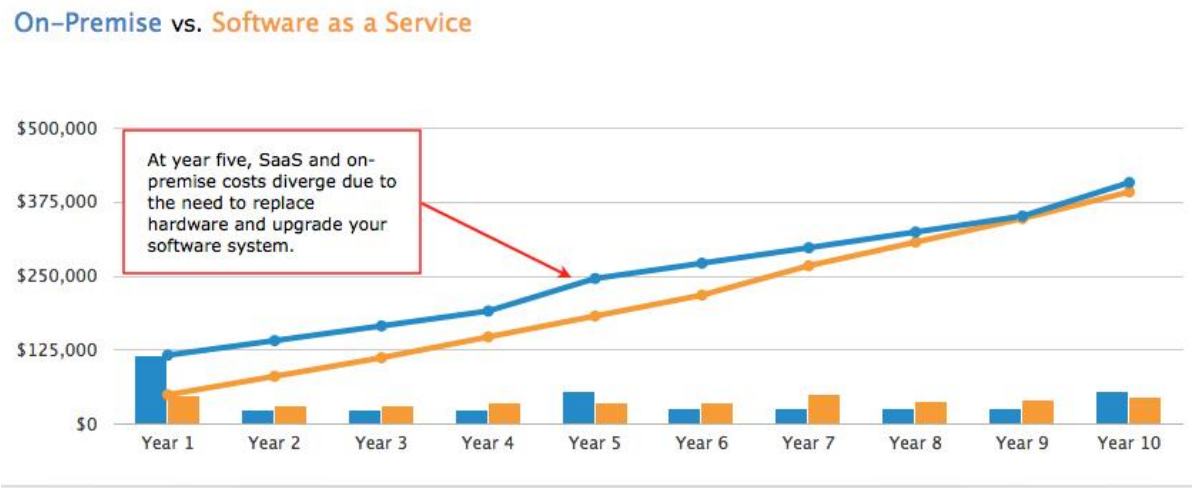

FIGURE 3: SAAS VS ON-PREMISE COST DIVERGE CHART

2. The Printing Industry in Macedonia

As a 7th industry in Macedonia, in the number of companies registered as Printing and reproduction of recorded media, printing industry has significant impact on the economy in Macedonia (СТАТИСТИЧКИ ПРЕГЛЕД: Индустрија и енергија, 2016). With an estimate of over 400 firms registered in this sector now days in the country, printing companies come in different sizes. From micro firms with up to 10 employees, small firms up to 50 employees and mid-size firms with up to 250 employees.

The average salary in this industry in year 2016 has been recorded to be 18.243,00 denars.

Nevertheless, the past few years have been difficult in this sector and the numbers have confirmed it. In 2013 the number of registered printing companies has been 443. The next year 2014 it dropped to 412. And in 2015 it came to 406 companies registered in this sector.

In spite of all the political and economic challenges, the printing industry still holds its grounds and manages to continue standing in this windy business environment. Companies

continue investing in new machinery, in new product lines and in spite of the political interferences, most of the printing companies manage to hold their business stable.

Either way, progress has been difficult trough the past few years. Statistics suggest stagnation in the prices as the Industrial producer price indices on the domestic market gives the following results by the past few years: (previous year = 100)[1]

- 2011 -101.4
- 2012 - 99.6
- 2013 - 102.7
- 2014 - 101.0
- 2015 - 100.2

The real progress in this industry is made by doing export. Printing houses that sell products to foreign countries have shown significant progress and ability to raise standards in this industry. Although our printing companies are frequently asked by companies from the European Union for quotes, many can't reach the quality standards required.

Still, this industry has shown its ability to grow and overcome obstacles on its way. Many of the printing companies have invested in IT departments within. That has increased the quality of the printed media and has opened a door for automating business processes.

2.1 Analysis of the printing industry in Macedonia in the past few years

Certain progress has been made in the printing industry and the paper industry in Macedonia in the last few years (АКТУЕЛНИ СОСТОЈБИ ВО ИНДУСТРИЈАТА НА ХАРТИЈА И ЦЕЛУЛОЗА, ГРАФИЧКА ИНДУСТРИЈА И ИЗДАВАЧКА ДЕЈНОСТ, 2016). Companies that saw opportunities in high quality printing of all paper and graphic products have shown high progress. Especially high progress has been noticed in the packaging production.

[1] REPUBLIC OF MACEDONIA STATE STATISTICAL OFFICE - STATISTICAL REVIEW: Industry and Energy (2011-2015)

Mainly, production has been pointed to the needs of domestic market. Paper manufacturers have shown decrease in production, which led to continuous increase in import in Republic of Macedonia in the part of the raw material import of cellulose and paper waste.

In the last few years, it's been noticed some interest in foreign companies to invest in the printing industry in Macedonia, which accelerates the process of modernizing these manufacturing industries.

The dynamic developments occurring recently in this industry, created positive atmosphere for investments in the printing industry in modernizing equipment, machinery and implementing new technologies.

When analyzing the structure of the economic entities in the printing industry in Macedonia, 90% of them are small companies and only 10% are mid-size companies. That underlines their flexibility and adjustability on the market's changes.

According to the statistical data from the State Statistical Office, the printing industry contributes in the State's GDP with 0.15% (year 2014)[2].

For the same year 2014, the data for the industrial production percentage indicates contribution of the printing and publishing industry with 3.12%.

In the paper and cellulose industry, as well as in the printing and publishing industries in year 2015 the number of employees was recorded to be 3 984 people (0.8% from all employees in the country), which is increase by 3% from the previous year 2014 when it was 3 867 people.

Comparisons of the indices of industrial production in 4 months in 2015 and 2016 show decrease by 8.7% in the printing and publishing industries in Macedonia.

The paper and cellulose industry and the printing and publishing industries appear to have issues with finding labor force and also insufficient labor for maintenance of machinery in the companies, which creates major problems in the current operations of companies from these industrial branches.

[2] Актуелни состојби во индистријата за хартија и целулоза за 4 месеци од 2016 година – Economic Chamber of Macedonia report for recent circumstances in the industry of paper and calulose for 4 months from 2016

Also, one of the problems noticed in these industries is the liquidity, which attracts additional problems in their current operations.

The business environment provides a small selection of funding instruments, with relatively expensive sources of use. In external sources of funding, the bank loan is basic. However, this source is hardly accessible to most companies in these industries.

2.2 Procedures for finishing printed products

Having already explained the printing technologies, when it comes to the procedures of printing and finishing a product, everything is different depending on the technology in use. Each printing technology has different procedures, some are easier as clicking the button "Print", and some are quite complex with several procedures that has to be done to finish a product like the offset printing. Usually, when a large quantity of some product is required, the obvious choice is to print it in offset. It is cheaper and faster. But if it is a small quantity product, it is ought to be printed in digital printer. It is important to understand that the final product will look slightly different when printed digitally vs. offset, as well as from printer to printer. Proper and consistent paper selection is also a critical component of the process because color appears distinctively on different paper stocks and with or without finishes (varnish, aqueous coating, etc.).

2.2.1 Prepress

Prepress is the term used in the printing and publishing industries for the processes and procedures that occur between the creation of a print layout and the final printing (Prepress, 2019). The prepress procedure includes the manufacture of a printing plate, image carrier or form, ready for mounting on a printing press, as well as the adjustment of images and texts or the creation of a high-quality print file. In today's prepress shop, the form of delivery from the

customer is usually electronic, either a PDF or application files created from such programs as Scribus, Adobe InDesign or QuarkXPress.

The following items have each been considered part of prepress at one time or another:

- Typesetting involves the presentation of textual material in graphic form on paper or some other medium. Before the advent of desktop publishing, typesetting of printed material was produced in print shops by compositors or typesetters working by hand, and later with machines.
- Copy-editing, is the work that an editor does to improve the formatting, style, and accuracy of a manuscript. Copy-editing is done prior to the work of proofreaders, who handle documents before final publication.
- Markup is an artificial language using a set of annotations to text that give instructions regarding the structure of text or how it is to be displayed. Markup languages have been in use for centuries, and in recent years have also been used in computer typesetting and word-processing systems.
- Proofing involves creating an accurate facsimile of the artwork before beginning production runs. This serves as a bond between the printer and their customer that the final product meets an agreed upon standard. Proofs in general can be done for all parts (images, illustrations, texts and colors) of print product. In this part, three types of proofing should be checked and printed out: the print-ready PDF files, the printer's proof and the imposition proof. Print-ready PDF files should be made after the layout using preflight at the printing house. The printer's proof should be printed out in high-resolution and checked by the customer. The imposition proof, which is usually done by the printers, should also be printed out to check and adjust the printing press.
- Proofreading traditionally means reading a proof copy of a text in order to detect and correct any errors. Modern proofreading often requires reading copy at earlier stages as well.
- Screening and adjustment of a continuous tone of images such as photographs
- Imposition, or the combination of many pages into a single signature form.

- Separation, or specifying images or text to be put on plates applying individual printing media (inks, varnishes, etc.) to a common print.
- Manufacturing of plates. The usage of different materials of plates should meet the needs of printing method. Usually rubber, plastic and aluminum are used for plates as well as film which is the photomechanical exposure and processing of light-sensitive emulsion on a printing plate. Manufacturing of plates should be well planned and delivered beforehand. Also, the cost should be calculated as well.
- Manufacturing of a high-quality print (PDF) file, which is used for the final printing.
- Paper select, choosing a proper paper is also a very important step in prepress.

In most modern publishing environments, the tasks related to content generation and refinement are carried out separately from other prepress tasks, and are commonly characterized as part of graphic design. Some companies combine the roles of graphic design and prepress production into desktop publishing usually called DTP.

FIGURE 4: PRE-PRESS TOOL AND COLOR SPECTRUM

The set of procedures used in any particular prepress environment is known as a workflow. Workflows vary, depending on the printing process (e.g., letterpress, offset, digital printing, screen printing), the final product (books, newspapers, product packaging), and the implementation of specific prepress technologies. For example, it is not uncommon to use a

computer and image-setter to generate film which is then stripped and used to expose the plate in a vacuum frame; this workflow is hybrid because separation and halftoning are carried out via digital processes while the exposure of the plate is an analog one. That demonstrates that the borders around the prepress are very fluid. Furthermore, – depending on the printing method and the print product – the elements of the prepress of a graphic print production can differ from case to case. This circumstance requires a management of the workflow. It is necessary to manage the responsibility for each part of the workflow. That can mean that employees, who are actually responsible for other parts of the production (e.g. Layout), have to attend to parts of the prepress.

2.2.2 Printing and Technologies used for printing

In order to better understand printing processes we have to list the types of technologies used for printing (Printing processes, 2017):

- Offset lithography
- Flexography
- Digital printing: inkjet & xerography
- Gravure
- Screen printing

2.2.2.1 Offset lithography

In offset lithography a printing plate, which is most often made from aluminum, contains an image of the content that needs to be printed. When the plate is inked, only this image part holds ink. That inked image is subsequently transferred (or offset) from the plate to a rubber blanket and then to the printing surface. The process can be used to print on paper, cardboard, plastic or other materials, but these have to have a flat surface.

Below is a picture of a 4 color sheet-fed printing press. At the far end is the intake where individual sheets of paper are automatically fed into the press. The 4 towers or printing units each print one color, typically black get printed first, followed by cyan, magenta and yellow. The stack of printed sheets is visible on the front of the machine, underneath the press console & monitor which the press operator uses to control the press.

FIGURE 5: 4 COLOR OFFSET MACHINE

For higher volume work offset presses use rolls of paper. The picture below shows such a much larger web press. It is so fast that the printed paper needs to be force dried. The black unit at the end of the press is an oven.

FIGURE 6: 6 COLOR OFFSET ROTO MACHINE

Offset is nowadays the most widely used printing technique for an extensive range of products such as books, newspapers, stationery, corrugated board, posters, etc.

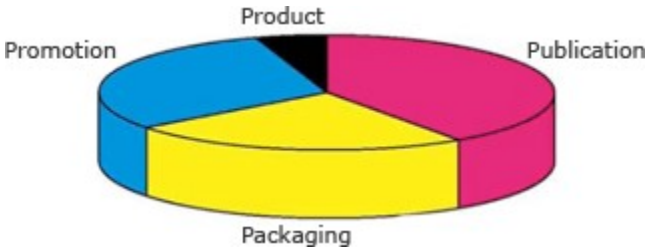

FIGURE 7: OFFSET PRINTING PIE BY SECTOR SHARE

There is a trend that printing promotional material is gradually migrating to digital printing while some packaging printing is moving to flexo.

2.2.2.2 Flexo

In flexography the content that needs to be printed is on a relief of a printing plate, which is made from rubber. This plate is inked and that inked image is subsequently transferred to the printing surface. The process can be used to print on paper as well as plastics, metals,

cellophane and other materials. Flexo is mainly used for packaging and labels and to a lesser extent also for newspapers.

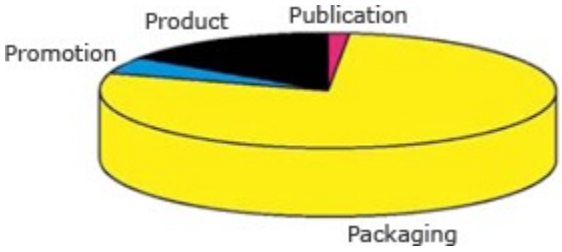

FIGURE 8: FLEXO PRINTING PIE BY SECTOR SHARE

Some packaging printing is moving from flexo to digital.

2.2.2.3 Digital printing

Digital printing can be done in various ways. Two technologies dominate the industry:

- Inkjet – In an inkjet printer the image that needs to be printed is created by small droplets of ink that are propelled from the nozzles of one or more print heads. Inkjet devices can print on a wide range of substrates such as paper, plastic, canvas or even doors and floor tiles. Inkjet printing is used a lot for posters and signage. It is also economical for short run publications such as photo books or small runs of books. In-line inkjet printers are sometimes combined with other types of presses to print variable data, such as the mailing addresses on direct mail pieces. The press shown below is the HP PageWide C500, meant for printing on corrugated board.

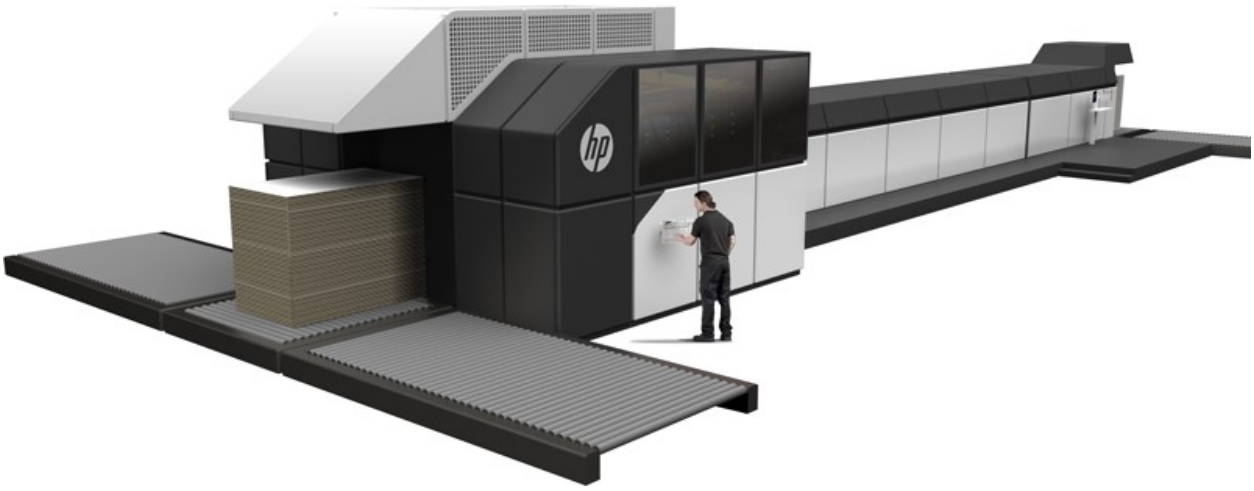

FIGURE 9: HP PAGEWIDE C500

- Xerography – In xerographic printers, such as laser printers, the image that needs to be printed is formed by selectively applying a charge to a metal cylinder called a drum. The electrical charge is used to attract toner particles. These particles are transferred to the media that is being printed on. To make sure the toner is fixed properly, the substrate passes through a fuser that melts the toner into the medium. Laser printers are not only used in offices but also for small run printing of books, brochures and other types of document. These printers are also used for transactional printing (bills, bank documents, etc.) and direct mail.

In 2009 both techniques jointly accounted for around 15% of the total volume of print.

FIGURE 10: DIGITAL PRINTING PIE BY SECTOR SHARE

Digital printing is increasingly utilized for print jobs that were previously printing using offset, flexo or screen printing.

- In short run small format (A3 size) printing, digital is taking over from offset for both color and B&W printing. Quick printers and copy shops print digitally on presses from vendors like Xerox, HP, Canon, and Konica Minolta.
- Labels are also increasingly being printed digitally.
- Billboard and point-of-sale or point-of-purchase jobs are being done by wide-format inkjet devices.
- There is a wide range of small format printers used to print on phone cases, mugs and other products.
- In book printing publishing companies start to rely more on print-on-demand. The Espresso Book Machine pictured below is well suited for that job.

FIGURE 11: DIGITAL PRINTER

There are a number of other digital printing processes that are geared towards specific niche markets:

- Dye-sublimation is a printing process in which heat is used to transfer a dye onto the substrate. Dye-sub printers are mainly used for printing on textiles, for proofing and for producing photographic prints. Some printers can print on a variety of materials such as paper, plastic, and fabric.
- In the direct thermal printing process heat is used to change the color of a special coating that has been applied to paper. This process is used in cash registers but also to

add markings, such as serial numbers, to products. For this a transparent ink is used that changes color when a laser applies heat to it.

- In the thermal ink transfer printing process heat is used to melt print off a ribbon and onto the substrate. It is used in some proofing devices but seems to be gradually disappearing off the market.

2.2.2.4 Gravure

Also known as rotogravure, this is a technique in which an image is engraved into a printing cylinder. That cylinder is inked and this ink subsequently transfers to the paper. Gravure is used for high volume work such as newspapers, magazines, and packaging.

FIGURE 12: GRAVURE PRINTING PIE BY SECTOR SHARE

Gravure is gradually losing market share to offset for publication printing and to flexo for packaging applications.

2.2.2.5 Screen printing

As its name implies, this printing technique relies on a screen, which is a woven piece of fabric. Certain areas of this mesh are coated with a non-permeable material. In the remaining open spaces ink can be pushed through the mesh onto a substrate. The advantage of screen

printing is that the surface of the recipient does not have to be flat and that the ink can adhere to a wide range of materials, such as paper, textiles, glass, ceramics, wood, and metal.

The image below shows a screen printing press that is used to print t-shirts.

FIGURE 13: SCREEN PRINTING MACHINE

Increasingly screen printing is being replaced by digital printing.

2.2.3 Cutting/Trimming, Folding, Laminating, Scoring, Perforating, Stitching, and Binding

After a job is printed, the next stage includes one or many steps depending on the end product: cutting/trimming, folding, laminating, scoring, perforating, stitching, and binding. All these processes require different number of workforce. For example for trimming/cutting usually it takes 2 people, for binding (for example books) usually 3-4 people must be included in the process and for folding or stitching it takes one.

FIGURE 14: BINDER

FIGURE 15: 3-KNIFE TRIMMER

All of these jobs, must be done by at least one specialist for each machine. Since it is heavy machinery, everybody included in the processes must be cautious at all times to avoid injuries.

2.2.4 Delivery

The last step in the bindery stage includes packaging for delivery.

2.3 Problems in printing processes

Managing printing processes is often quite difficult. Since it has so many variables, problems can occur at any stage and completion time can vary. Many machines are included in the process and sometimes any of them can fail to complete the job. A lot of these issues can take more than a couple of days fixing and can be quite expensive. Sometimes the requested paper can be difficult to acquire, and the wait for the supplier to bring it can take a few days. Machine's technicians are vital for the process, and this labor must be healthy and be on the

workplace in order to finish the product on time. That is why secure labor from injuries is very important.

When printing for example offset print and also when developing printing plates, certain conditions has to be met. The temperature has to be warm enough for the process to run smoothly. Paper needs to be appropriate and mustn't be electrified. Otherwise it makes problems when it gets in the offset printing machine.

FIGURE 16: OFFSET PRINTING MACHINE

Especially complicated becomes when jobs have close deadline and machines have to work 24 hours. Managers have to extend labor capacities and hope that everything will go as planned.

Problems extend to mistaken color of the print, low color, problems with paper direction, problems with folding paper, cutting problems, lamination problems, binding mistakes, delivery damages etc.

Another important role for proper finish of the product is the final electronic version of the product (usually .pdf document) sent by the client. If the product document sent is found with a small mistake at a late stage of the printing process, a delay of couple of days will take place. If it is a significant mistake, let's say a book is printed and more than 5 pages are mistaken, then the whole book has to be reprinted.

2.4 Analysis of the Printing industry in the US and Worldwide

Printing plays a significant role in the U.S. and Worldwide economies (Print is big, 2016). Despite the myths we may have heard, print is big, print is green and print is here to stay.

Print is the original disruptive technology and brought knowledge to the masses. Today print is one of the largest industries in the world. Print rivals auto-manufacturing[3] and is more than 8X bigger than video games[4]. While print technology and applications are certainly transforming, it is still growing every year worldwide.

- **The global print industry is worth $898 billion and drives $3.8 trillion in related services.**
- The global online advertising industry is worth $133 billion
- The global video game industry is worth $102 billion
- The global music industry is worth $15 billion

*The US auto industry is worth $1.1 trillion.[3]

Print represents 80% of 2015 book sales worldwide[5].

There are a lot of interests competing for marketing dollars today. As a result, the myth of print not being environmentally friendly has been very well promoted. The print industry, in

[3] TrueCar
[4] Statistica
[5] Deloitte

fact, is not only environmentally friendly but is one of the most sustainable industries around[6]. The industry makes tremendous investments in applying renewable energy sources and creating environmentally friendly supplies[7].

Dr. Patrick Moore, the co-founder of GreenPeace, says "To address climate change we must use more wood, not less. Using wood sends signals to the marketplace to grow more trees".

*Over 51 million tons of paper was recovered from recycling in 2015. Enough to fill the Empire State building 124 times[8].

*Globally only 17% of cut forest trees are used for the paper industry[9].

*There are 20% more trees in the U.S. today than on Earth 40 years ago[10].

In the last decade, while the digital marketing space has gotten noisier and considerably less effective, print has enjoyed a renaissance of increased conversion rates and marketing return on investment. Print is 43% less annoying than the internet[11]. Customers actually appreciate getting a nice postcard, well-designed catalog, or personal thank you note in the mail today[12].

*10.6 million United States jobs in 2007 depend on advertising mail[10].

*US advertisers spend $167 per person on direct mail to earn $2,095 of goods sold – a 1,255% return.

*Direct mail increases online donations by 40%[13].

*96% of news reading is still in print[14].

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[6] DMA
[7] American Forest & Paper Association
[8] American Forest & Paper Association
[9] TAPPI
[10] DMA
[11] Roper Public Affairs survey
[12] United States Postal Service
[13] Dunham+Company
[14] Nieman Foundation for Journalism at Harvard

*Print is 59% more engaging for users than online articles[15].

*80% of households read or browse their advertising mail[12].

In only a few years many innovative companies have built impressive businesses combining the instant gratification of online with the physical printed world. Some have even discovered unique ways to harness the fleeting concept of social media in print form. Now, print companies ranging in size from your favorite local copy shop to the multi-national packaging manufacturer, are quickly moving online[16]. They are doing so at an increasing pace to keep up with their customers' 24/7 expectations and to take advantage of the extended reach the Internet brings.

[15] Ball State University
[16] InfoTrends / CAP Ventures

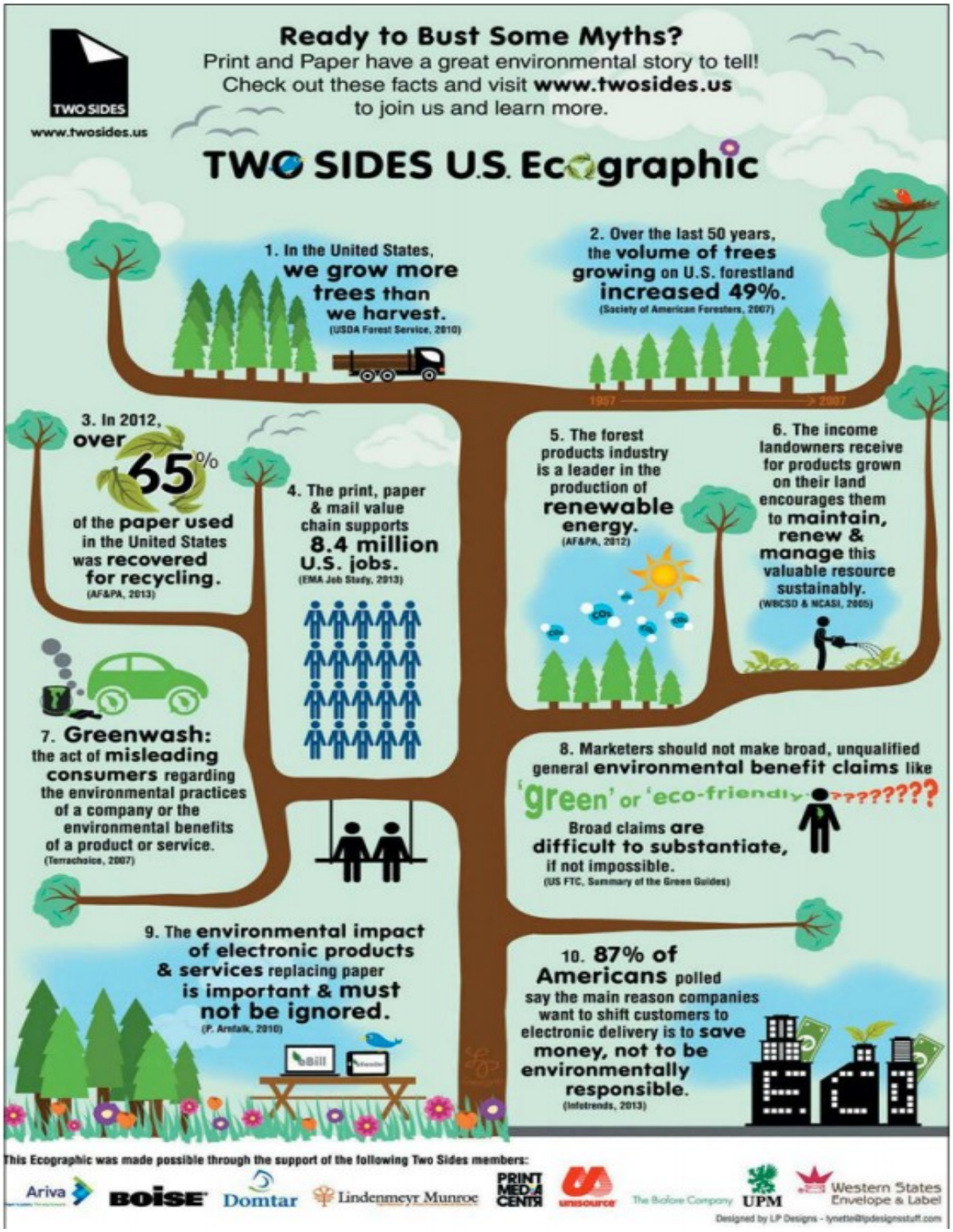

FIGURE 17: PRINTING PAPER AND THE ENVIRONMENT

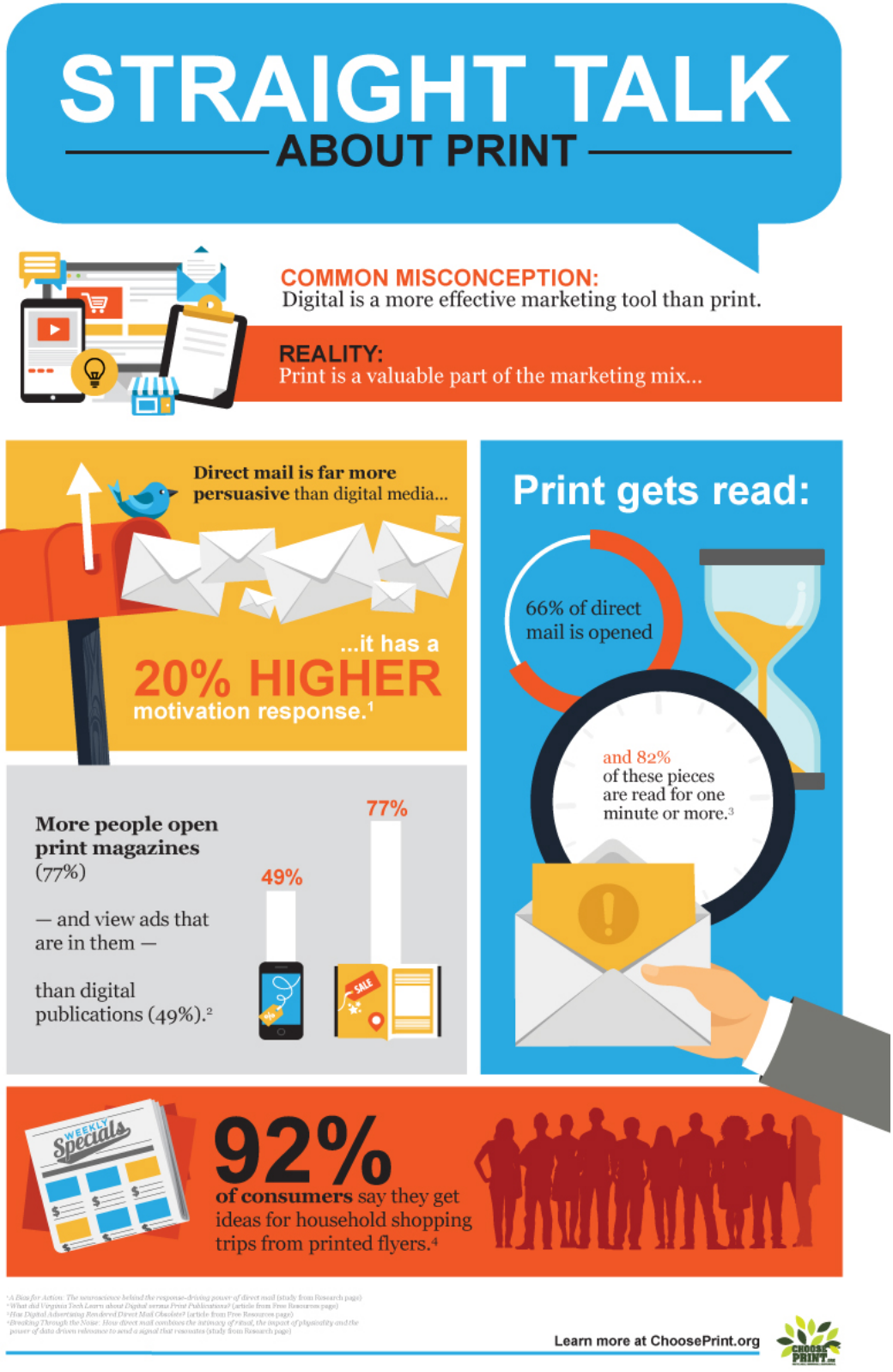

FIGURE 18: DIGITAL VS PRINTED MARKETING

The global printing industry is forecast to reach $980 billion by 2018, driven by growth in packaging and labels, rather than graphic applications, and digital rather than analogue printing, according to a new market report by Smithers Pira (Global printing market to top $980 billion by 2018, 2014).

The Future of Global Printing to 2018 provides a detailed five year forecast of the global printing market. Based on expert research and analysis, this report contains more than 325 tables and figures revealing essential industry trends and information on technology.

Global printing markets are changing, many publishing products have electronic versions replacing previously printed volumes. E-books, on-line newspaper and magazines are taking significant sections of their respective markets, while directories, catalogues and brochures have electronic alternatives, more transactions are electronic reducing demand for currency and cheques and advertising spend is moving into new areas including on-line. These factors, alongside the continued growth of social networking, result in declining volumes of many print products, but not packaging and labels where demand is growing.

The print technology in use is also changing. Digital printing is now taking much more share, particularly in graphics (i.e. non-packaging applications). Digital's share of the whole market doubles in constant value terms from 9.5% in 2008 to 19.7% by 2018, when packaging is excluded this share is 23.5% in 2012 to 38.1% by 2018 although the print volume share remains low, according to Smithers Pira. Digital generally commands much higher values, with print suppliers demonstrating the effectiveness of the products.

While the printing and printed packaging sectors are global, regionally there are very different market developments with the more mature sectors providing technology transfer and second hand equipment into the emerging regions. Many customers are global, with advertisers, publishers and packaging buyers demanding high quality, consistent products everywhere.

The USA is the world's biggest print market but the printing future landscape will change within the next five years, forecasts The Future of Global Printing to 2018. In 2014 China will overtake the United States in print volume terms after many years of very strong growth across

all areas of print and in constant value terms in 2018. India will move up from tenth to fifth in the period. Mexico, Brazil and Russia will move up the tables with the mature markets all losing position. These relative changes are important for print supply companies as they demonstrate where the consumable volumes and appetite for investment continue to lie.

4. ERP Solutions in the printing industry

Many printing and packaging companies, over the years, have installed and tried to implement generic Enterprise Resource Planning (ERP) systems (Five Reasons Why Generic ERP Doesn't Work for Printing and Packaging (An Epicor and Kodak White Paper), 2013). A good idea, it would seem, because ERP has helped thousands of companies around the world improve operations, cut costs, and better manage resources to deliver superior customer service and profitable growth.

If the question is "What system tools can help a printing and packaging company improve customer service, control costs, optimize use of resources, communicate internally and externally, and position the company for growth and success?", the answer is definitely ERP. But it has to be ERP that is designed and built to accommodate the specific needs of the printing and packaging industry.

And don't think that modified, adapted, or enhanced ERP will work. The differences and needs of printing and packaging are so fundamental to the basic structure of how ERP works that modification and work-arounds will not suffice.

Printing and packaging companies should look for an ERP system that is designed specifically for their industry with estimating, product and job structuring, scheduling, and material control capabilities that are properly attuned to the specifics of their world. These fundamental capabilities, however, should be tightly integrated with industry-leading customer relationship management (CRM), workflow, quality, and supply chain management applications for a comprehensive enterprise solution.

4.1 ERP Bills and Routings

ERP consists of basic operational applications for inventory management, production, scheduling and control, planning, activity control (purchasing, customer orders), and related accounting, financial management, and support. The heart of the system is the planning 'stack'—a set of applications that support sales and operations planning (long term), master scheduling (medium term), and requirements planning (short term). Execution applications focus on material (inventory) control, production control, and purchasing.

Much of what the system does depends on basic definitions (called product data) that define items, bills of materials, and routings. You can see already that ERP terminology is manufacturing oriented, not printing. And that's really at the heart of the problem. Generic ERP is designed for a manufacturing environment where individual pieces or quantities of material are put together to make products.

The original ERP design was developed for a typical 'discrete' manufacturing company—one that works with individual pieces and parts. Later variations were developed for 'process' industries like pharmaceutical and chemicals where materials and products are liquids or powders that are measured (rather than counted). Still, the orientation is to some number of parts or materials coming together to make one (or a defined quantity) of a specific product.

The bill of materials (BOM) defines this relationship and, in most cases the user is expected to pre-define the BOM then forecast demand, release work orders, and account for quantities of the item made and the components that go into it. That's simply not the way a typical printer does business.

Commercial printers will often define the job in order to prepare the bid, and then run the job shortly thereafter if the bid effort is successful. A 'standard' job that is repeated frequently is a rarity. Repetitive business is more common in labeling and packaging, so this organization is not a major concern in that style of business. Other concerns listed below, are important to label and packaging printers, though.

There is a segment of manufacturing that does operate more like a commercial printer—one-off jobs that are defined and run once, unlikely to be repeated. That segment is

called a ‘job shop’ and there are a small number of ERP software products keyed to this industry segment.

Nevertheless, even job shop software suffers from the manufacturing-centric, pieces-into-products orientation that doesn’t fit the printing and packaging industry.

Picture this: to enter a print job into a generic ERP system, first define the ‘items’. Create records for the finished product and each component—paper, ink, plates, etc. Now link them in a BOM and specify the quantity of each component required to make one end product. Already it’s complicated.

Each end product (page, carton, flier, etc.) probably contains one sheet of paper but you have to allow for set-up and overrun waste. And the paper may come in large sheets to be printed 2-up or 4-up or perhaps even a fraction of a sheet because you want to lay-up multiple jobs on a single sheet/run. How much ink of each color (in ounces, milliliters, or pounds) ends up on each page, including allowance for set-up, waste, clean-up loss, etc.? These are not trivial questions when trying to force-fit printing into a standard manufacturing BOM. This all takes time, and it doesn’t help at all with imposition, make-ready or run time calculations, or any of the other details that make printing different from assembling a toaster or machining a casting.

4.2 ERP Estimating

Most printing work is highly competitive. Price, turnaround and customer service are often the winning attributes that mean the difference between a successful, growing printing business and a struggle for survival. The ability to quickly generate an accurate estimate is a key capability in all three areas.

The estimate must be detailed and accurate to properly price the bid—so that you have the best opportunity to win the business and will not be surprised by unanticipated costs later. Speed in developing the estimate is an important part of turnaround, and a significant contributor to responsiveness (a key factor in customer service).

An estimating system for printing and packaging must handle imposition, folds, and the ability to automatically create job plans including material estimates (e.g., ink and varnish coverage, grip allowances, paper usage per section, etc.), and make-ready and run times.

The estimating process should include wizards to simplify bid preparation, and the ability to call in saved examples ('standard' jobs, past estimates, previously completed jobs) to use as a template or starting point for new estimates.

All this adds up to speed and accuracy. You want to be able to prepare bids and estimates the way you would do it manually, but with computer-aided efficiency. In addition, you should have the ability to try substitute material and run parameters (different paper weight or board specification, different press, etc.) to test how costs would change—to identify the best strategy for meeting the customer's needs and securing profitable business. Once the order is signed, the estimate specifications should be electronically transferred to the scheduling and management systems for execution—no re-keying and no risk of errors in transferring the specs into production.

4.3 ERP Scheduling

As mentioned earlier, generic ERP assumes that one bill of materials identifies the components needed to make one product. Job scheduling and tracking work the same way—one job makes one product. That's not always the case in printing and packaging.

Quite often, one press run will include several 'products' run at once that are cut into separate items at a later time. While there may be elaborate and cumbersome work-arounds to accommodate this situation in generic ERP, it is not simple and it is not convenient because it is not a 'natural' situation from the perspective of the system's design.

The opposite is also true. When printing a job that involves several components (pages, covers, sections on different stock, some color pages and one color sections), ERP will force separate work orders for each part of the job plus another (or several others) to assemble the

pieces into the final product. Each work order involves a separate definition, release, transactions, and completion. If some of those press runs include parts of multiple jobs, that complicates it even further.

A system designed for printing and packaging will view these situations as everyday business, allowing easy configuration of the items or pages on the lay-out and routine scheduling of the make-ready, press run, cutting, and finishing. Once the job is complete to the point that easily identified output products are produced, straightforward inventory control, binding, packaging and shipping processes apply.

4.4 ERP Materials and Specifications

Typical discrete manufacturing deals in whole units—one frame plus two wheels make a bicycle. Process manufacturing works with measured quantities—325 milligrams of active ingredient plus 850 milligrams of filler make an aspirin. Neither style of generic ERP has the capability to handle material characteristics like paper specifications, sheet size, ink coverage, Web width, conversion of sheet to weight and back, PANTONE® colors…the list goes on.

Generic ERP lacks the ability to gracefully handle over-runs and under-runs. There are no built-in calculators for determining make-ready and run times. Turning signatures into press runs, bindery jobs, and end products is problematic. And pricing calculations that recognize these characteristics do not exist in generic ERP.

4.5 ERP Doesn't Understand Printing and Packaging

It should be clear that generic ERP is ill-suited to support the basic needs of the printing and packaging industry. That being the case, you can't expect the supplier, its agents, representatives, business partners, or distributors to understand your needs. If you were to purchase one of these generic packages, the sales team might also propose extensive modifications (at considerable cost and an extended implementation time to allow the programmers to get it done) but it is doubtful that the end result would be as complete and

appropriate as a package that was designed for your industry from the beginning, by people who truly understand your needs.

Don't forget, though, ERP is the tool for effectively managing the business and delivering outstanding customer service, responsiveness, cost control, efficiency, and visibility throughout the supply chain. The functions of a firstclass ERP system including inventory control, production planning and scheduling, financial management, customer service and purchasing are as important to the printing or packaging manufacturer as they are to manufacturers in other industrial sectors. They, too, should look for suppliers that understand their particular industry and have built functions into the software that support their specific needs.

ERP (of any variety) should be built on a 100% service-oriented architecture (SOA) platform and include workflow, CRM, lean manufacturing, and supply chain capabilities. Using SOA technology and Web services, the system should be designed to easily connect with other applications—other apps inhouse and with partners, suppliers, customers, and business partners outside of the enterprise. For printing and packaging, this includes Job Definition Format (JDF) connectivity. SOA also enables the system to be customized without compromising the internal code (personalize the function and displays without modifying the programs).

Here's one final word about ERP packages. The functionality of today's ERP is so broad and comprehensive that it can't be duplicated to any usable extent in custom code. Even the largest companies in the world, the only ones that could afford the millions of dollars it would take to develop ERP functionality from scratch, buy and use packaged ERP products. Software development and support are not the core competence of a manufacturer or printer.

Packaged systems offer exceptional functionality at a price that is far less than custom development. Similarly, ongoing maintenance and support costs are much more reasonable since they are shared among a large community of users. Software developers make it their business to incorporate the best and latest technology and industry best practices in their systems to provide exceptional value to their customers.

5. Case study: How the art of printing was introduced to structure and efficiency?

Company: Printing House Naumovski

Location: Skopje, Macedonia

Labor: 7-15 employees

Challenge: Improve business processes, increase efficiency

A small Printing company from Skopje - Printing House Naumovski, with up to 15 employees, asked for ERP solution that could improve business processes in the firm. The company has been founded in 1989, and is used to doing things the old fashioned way.

A lot of problems were reported in the accounting and invoices department. A lot of mistakes were made in the process of making invoices that had impact on the company's profit. Before the implementation of the new ERP solution, invoices were made in Microsoft Word that resulted with incorrect calculations and big delays when more clients are in the office waiting to get the requested product.

Another issue was the warehousing. It was often a long process of determining the quantity of materials like paper or color boxes. That time was very often added to the delays in finishing products.

Every time the company had multiple jobs simultaneously, estimated finishing time was almost impossible to determine correctly.

Making a price for a requested quote was always dependable by the CEO, acquired more time and rarely resulted with mistakes.

Labor over hours work was often disorganized and depended of the employee's calculations.

Every year calculations of production quantity were based on CEO's memory of previous years. Often resulting in overproduction and decrease in profit.

5.1 Implementation of ERP software for Printing House Naumovski from Skopje

After conducting all analysis, surveys and interviews with the firm's CEO and the people involved in the processes, the application started building up from scratch. Having in account the flexibility and accessibility required, it was decided to make the ERP solution a web application that can be accessed from everywhere only by logging into the website. This means implementation time gets reduced significantly.

Since we needed a fast and efficient solution, C# and .NET technologies were used to create the system. Microsoft Visual Studio and Microsoft SQL Server were chosen for developing platforms. Web Forms framework was used to develop the application, since I had most experience with that technology. It may be obsolete to use Web Forms currently, knowing the impact MVC framework has in IT software development, but it did the job needed for this system.

The system consists of main home page, content page, authentication page, style and design files, client controls and of course the LINQ to SQL Data Classes. All functions are being programmed in the client controls (.ascx) and called in the content (.aspx) page. All general system functions are written in .cs file in the "App_Code" folder.

When all analysis were done, the following application functions were stated to be needed: efficient database, authentication, multiple access roles with different restrictions, main panel with view of current processes and urgent notes and reminders, management of processes, costs calculator, management of debts and claims, system for invoices, warehousing,

management of human resources, management of firms, management of products, management of transactions, notes, reminders and users.

FIGURE 19: ERP IMPRESION LOGIN PAGE

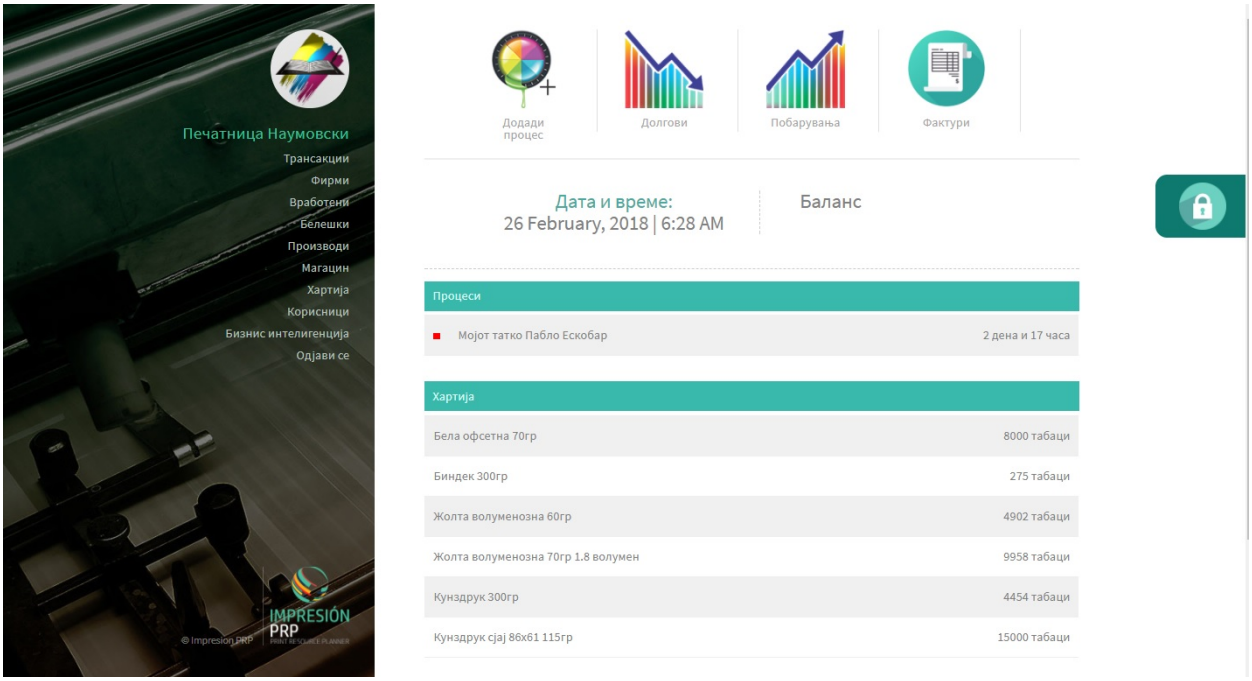

FIGURE 20: ERP IMPRESION MAIN PAGE

5.2 Results

Significant improvements were the result of implementing ERP system in the Printing house Naumovski.

Issues with the invoices were no longer happening. The speed of making one was dramatically increased and no mistakes were reported.

Knowing the quantity of materials in the warehouse was always available to the CEO. He reported no problem or lag in determining needs of materials for printing.

The long algorithm calculating processes including employees available, difficulty of task, number of pages, ¼ color or full color 4/4 print, binding options, lamination needs etc. made it easier to determine finishing estimates and easier to plan other tasks.

Special calculator of costs made it easier and faster to make a price when requested. CEO no longer had to spend time going through prices and formats of paper sheets. Now any senior employee can make the calculation and make the offer to the clients.

Labor management (Management of Human Resources) tool make it easier to keep track of all after hours and vacations of all employees. The toll makes sure labor is appropriately paid and no additional payments were miscalculated.

The business intelligence tool is helping the senior management determine the quantities that ought to be printed. Now they have full and exact picture of how the firm is standing on the market, and can make the right decision for the future.

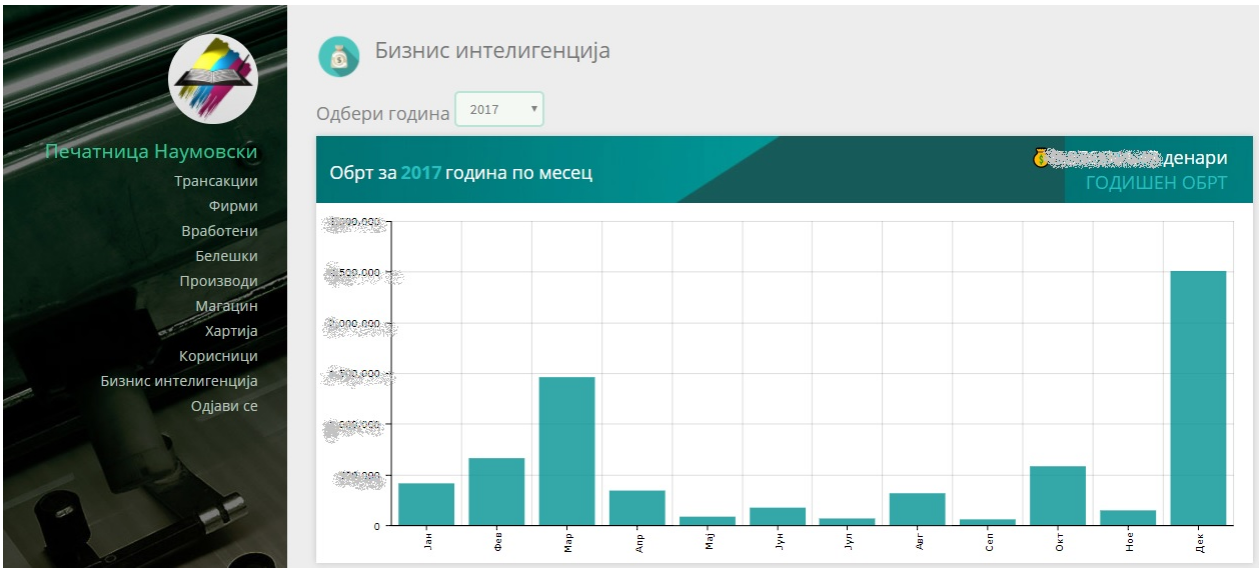

FIGURE 21: IMPRESION BUSINESS INTELLIGENCE PANEL 1

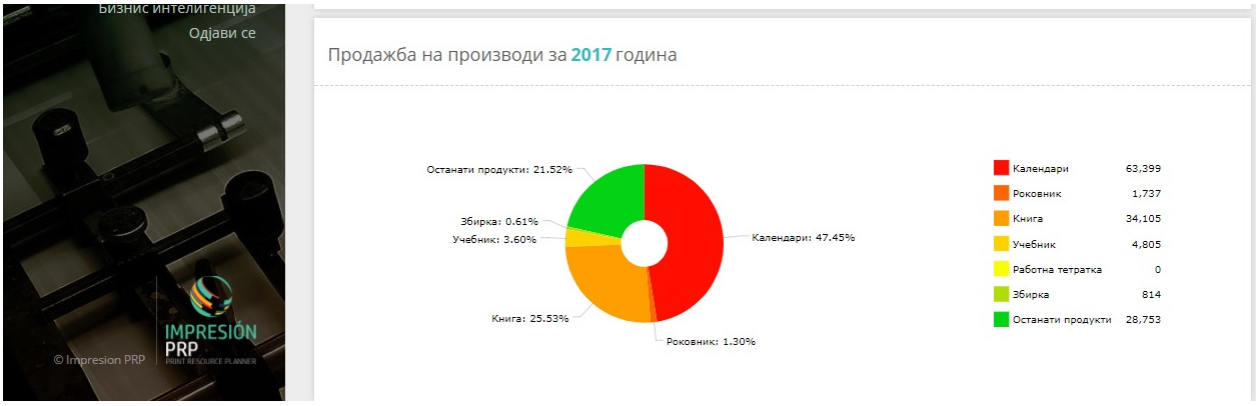

FIGURE 22: IMPRESION BUSINESS INTELLIGENCE PANEL 2

5.3 Problems reported

One problem was reported in implementing ERP system in this company. Labor was undereducated in IT technologies and wasn't able to input data in the system. Only one employee was IT educated and assigned to maintain the system and gather data for the company.

5.4 Conclusion

Even though these systems may cost a lot for Macedonian companies, especially small companies, this case study concludes that ERP software will help the business in many ways. In this case, the ERP made processes more efficient, more reliable, and less dependent that brought more profit to the company and more time for the CEO and senior management to get busy getting new jobs. Now, the art of printing can no longer be subjective.

6. Case Study Round-Up: Commercial Printing Business Management Software

Today's profitable commercial printing businesses increasingly rely on robust business software to help answer some of their toughest management questions, such as (Case Study Round-Up: Commercial Printing Business Management Software, 2014):

- How can we more accurately and efficiently communicate order information through the enterprise?
- How can we precisely assign costs to business sectors to improve our visibility of which areas are driving profitability and which need improvement?
- How can we maximize throughput and revenue opportunities by better leveraging our investments in human resources and equipment?

FIGURE 23: PRINTING MACHINE UP CLOSE

Each of the software options selected in the four case studies highlighted here represent very different approaches to solving these issues. The variety of solutions illustrates the reality that one size does not fit all when it comes to accounting, ERP, estimating, MIS, and business management software solutions for the print industry.

Let's take a closer look at each company's decision:

6.1 Dynamics NAV provides 50% reduction in order processing time

> "AFTER CONSIDERING OUR OPTIONS, WE CHOSE MICROSOFT DYNAMICS NAV OVER COMPETING OFFERINGS FOR THREE REASONS: SUPERIOR TECHNICAL FLEXIBILITY, THE PARTNER ECOSYSTEM, AND A LONG-TERM COST ADVANTAGE."
>
> JAMES O'BRIEN, PRESIDENT, PRINT MANAGEMENT PARTNERS.

Decision overview: Since their operations expand beyond commercial printing into distribution and business communication management services, Print Management Partners required the flexibility offered by a mainstream ERP solution.

Company Print Management Partners

Business model Business communications solutions, including printing, distribution, and marketing

Company size 100 employees

Product implemented Dynamics NAV by Microsoft

Implemented by Solution Systems

Key Objectives

- Respond more quickly to customer requests
- Decrease reliance on software vendor to make system changes
- Find a strong combination of functionality, flexibility, and cost-effectiveness
- Meet requirements of both distribution and print service operations

Positive Outcomes

- 50% reduction in time spent processing customer orders
- Fewer than 3 errors in every million transactions
- Support for global expansion via multi-language, currency, and tax support
- Ability to enact system changes, such as interface customizations, without vendor support

6.2 Accura Print MIS System provides commercial printer with new confidence in estimating accuracy and quick ROI

> "WHEN WE SAW ACCURA IT ALL MADE SENSE, IT CONNECTED ALL THE DOTS - THIS WAS SOMETHING WITH WHICH WE COULD WORK. THE PRICING OF ACCURA WAS ALSO VERY COMPETITIVE COMPARED TO OTHERS, AND HAD A MUCH LOWER 'COST-OF-OWNERSHIP' IN TERMS OF AN ONGOING FULL MAINTENANCE AGREEMENT."
>
> STEVE LARSON, CO-OWNER, C&D PRINTING.

Decision overview: With a focus targeted primarily on estimating and job costing requirements, C&D Printing chose a program strong in those areas, but which also offered additional modules to support future growth.

Company	C&D Printing
Business model	Litho, screen, and digital printing
Company size	20 employees

Product implemented Accura Print MIS System by Data Design Services

Key Objectives

- Identify option capable of scaling to provide e-commerce, file submission, pre-flighting, estimating, document review
- Understand the true costs of each job
- Streamline back-office operations

Positive Outcomes

- Less time spent on estimates and greater confidence in quote accuracy
- 12 month ROI on software investment
- 1 month deployment timeframe

6.2.1 The case study on Accura MIS's website

What was the situation before Accura was installed?

We were using a product called Franklin Estimator for a number of years (C&D Printing implementing Accura software, Case Study, 2018).

Why did you start looking for an MIS System?

We had hoped Franklin would carry us forward into the future with our business needs, but we could see limitations in the software.

We wanted an MIS to provide an end-to-end solution incorporating an e-commerce web portal, file submission, pre-flighting and generate pass/fail document for customer review. We also needed to streamline the back office operation to eliminate the need to have a full-time pre-flighting employee.

What prompted you to look at Accura?

Initially we discounted Accura because none of the other US printers we spoke to had heard of the program. We had numerous presentations from competitor products like EFi Pace, and were ready to make a buying decision.

After a lengthy telephone call with our local Spicers sales consultant about the concept of a truly modular system like Accura, our interest peaked and we felt we had to take a closer look.

Why did you ultimately decide to choose Accura?

We were very impressed by the "WebEx" introduction to Accura! We then realized that even after numerous demonstrations of EFi Pace, after hanging up the phone we were totally confused. Pace did not "flow" well, it was not logical or intuitive.

When we saw Accura it all made sense, it connected all the dots - this was something with which we could work!

The pricing of Accura was also very competitive compared to others, and had a much lower "cost-of ownership" in terms of an ongoing full maintenance agreement.

We ordered a 7 user Accura MIS in May 2011.

How has Accura improved business for you?

Previously we never really knew the true costs of producing a job. Franklin based pricing on published price lists, market trends and averages. As Accura is based on "cost-plus" principles we now know our costs and margins for each project BEFORE we agree on the final price with the client... in today's economy this is essential!

The new efficiencies gained with Accura will allow us to enjoy a ROI in less than twelve months! I can now spend less time working on estimates and have the confidence that jobs will be quoted accurately.

Would you recommend Accura to other printers?

Yes! If you're looking for a "best-in-class" print MIS written by printers, that can be installed and trained with such efficiency you can go live within 1 month; then I'd recommend you look at Accura. We were amazed to find such a complete solution at this price point.

What plans do you have to expand the system?

We will be implementing the Stock Control (Inventory) module, and developing products for our e-commerce storefront.

6.3 EFI PrintSmith helps digital printer capture additional $3,000 of billable costs in first month after install

> "SELECTING EFI PRINTSMITH WAS AN EASY DECISION. ITS INTUITIVE INTERFACE WAS A KEY FACTOR. FROM START TO FINISH – ESTIMATING TO INVOICING – IT WAS CLEAR THAT PRINTSMITH COULD OPERATE OUR BUSINESS SMOOTHLY."
>
> TODD WARREN, OWNER, MPI COMMERCIAL AND DIGITAL PRINTING.

Decision overview: MPI Commercial and Digital Printing needed to solve estimating and costing issues, but selected a product that allowed them to additionally incorporate invoicing, reporting, and e-commerce functionality.

Company MPI Commercial and Digital Printing

Business model On-demand digital printing of advertising and marketing materials

Company size Small business

Product implemented EFI PrintSmith

Key Objectives

- Update antiquated approach to price list management to assist with estimating
- Improve job reporting visibility to drill-down into costs
- More easily create invoices and access reports

Positive Outcomes

- Quicker invoice turnaround with fewer errors
- Capability to handle more work and add to the bottom line via improved efficiency
- $3,000 in billable work that previously would've been missed captured in first month alone
- Data driven decision-making via real-time report access rather than waiting until month-end

6.4 PrintVis shortens commercial printing invoice cycle from 10 to 3 days

> "THE ULTIMATE GOAL FOR THE BUSINESS WAS TO UNDERSTAND HOW OUR OWN BUSINESS WORKED, WHERE COSTS WERE INCURRED AND WHERE PROFITS WERE CREATED. FIRSTLY WE NEED TO HAVE A CLEAR AND EFFECTIVE FLOW OF INFORMATION FROM AREA TO AREA AND THEN USE THAT INFORMATION TO MAKE KEY DECISIONS. THE SYSTEM HAS GIVEN US CLARITY IN OUR THINKING TURNING DECISIONS THAT TRADITIONALLY COULD HAVE BEEN SEEN AS RISKY INTO AN ACTION BASED ON SOLID FACTS WITH DATA TO STRENGTHEN ITS CASE."
>
> ANDREW JONES, GROUP MANAGING DIRECTOR, STEPHENS & GEORGE PRINT GROUP.

Decision overview: Driven by the requirement for a holistic approach to accounting and operations management, Stephens & George Print Group chose an industry-specific commercial printing ERP system.

Company	Stephens & George Print Group
Business model	Litho printing, magazines and commercial products
Company size	220 employees
Product implemented	PrintVis
Integrated by	Crimsonwing

Key Objectives

- Integrate ordering, marketing, production, and finance into one manage platform

- Ease access to business intelligence via consolidated, single system reports
- Manage credit limits and control cash flow risks
- Integrate pre-press and press room job communication

Positive Outcomes

- Increased efficiency from commercial departments without additional labor expense
- Improved flow from estimate to order
- Elimination of support costs associated with supporting multiple programs
- Visibility for profitability drivers by assignment of costs to group, department, and cost centers
- Reduction of invoice times from 10 to 3 days

7. Survey: ERP Systems in the Printing Industry in Macedonia

A survey has been conducted in Macedonia in order to get more information about Information systems used in the printing companies. About their knowledge in ERP systems, their implementation costs and problems and the need for more information in that area. The survey was sent to all printing companies in Macedonia that are known to be able to implement such systems due to their capacity and size.

7.1 Survey Results

Fourteen firms answered the survey. On the figure below are shown the last five that filled the survey. The firms that answered are: Pecatnica Bato, Pecatnica Evropa 92, Kiro Dandaro, Maksten Grafika, Bato&Divajn, Polyesterday, Kabras, Propoint, Arcuss, Arberia Design, Sofija Print, Datapons, Pecatnica Naumvoski and Branko Gapo.

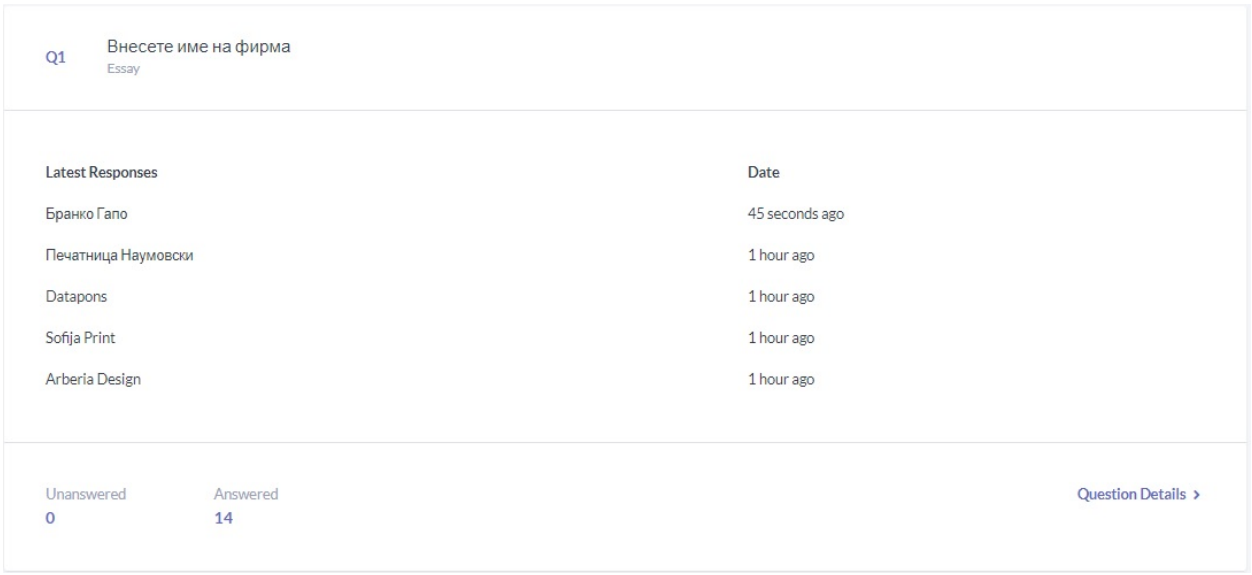

FIGURE 24: SURVEY RESULTS OF QUESTION 1

Next question is about the technology of printing that the firm is using. Most of them are offset printing companies, and some are using also digital printing. Only two of them use Flexo printing.

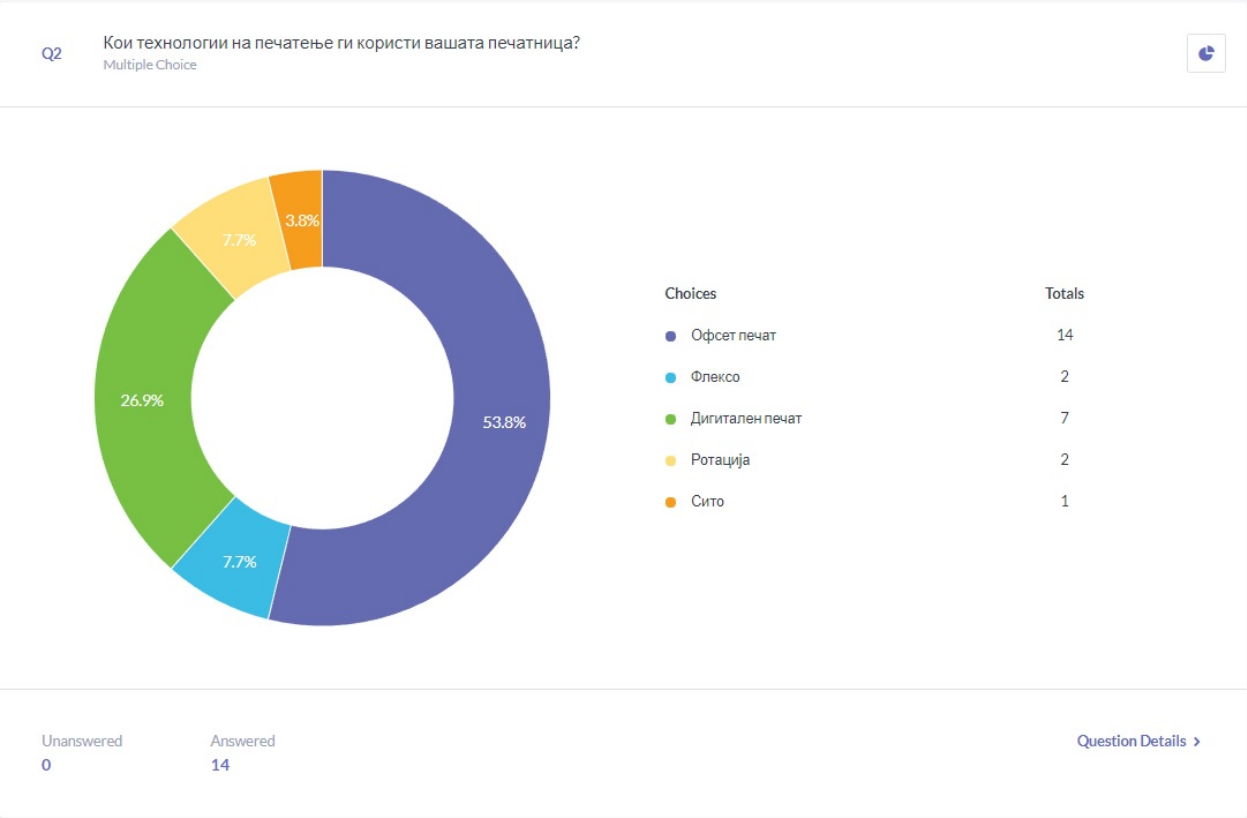

FIGURE 25: SURVEY RESULTS OF QUESTION 2

When asked about the number of employees that these firms have, we can conclude that most of them are small or middle size companies. Only one company has over 100 employees and that is Evropa 92.

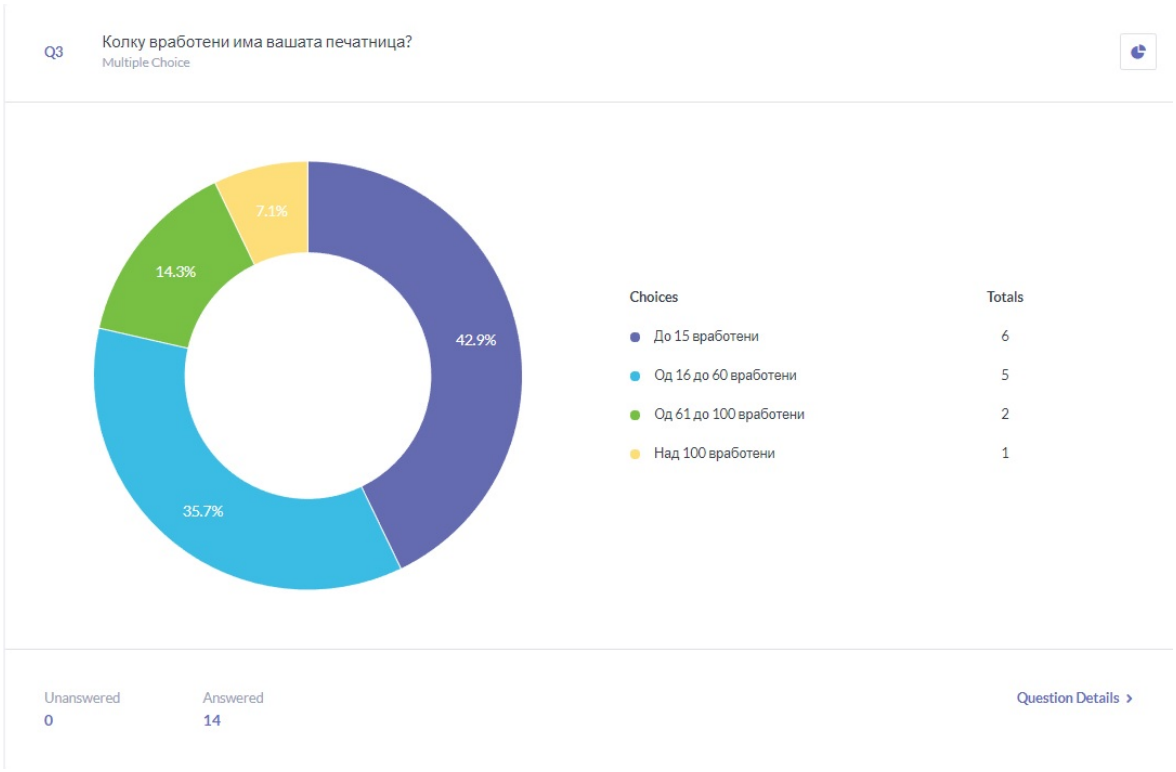

FIGURE 26: SURVEY RESULTS OF QUESTION 3

Asked if they are familiar with ERP systems, 4 out of 14 answered yes.

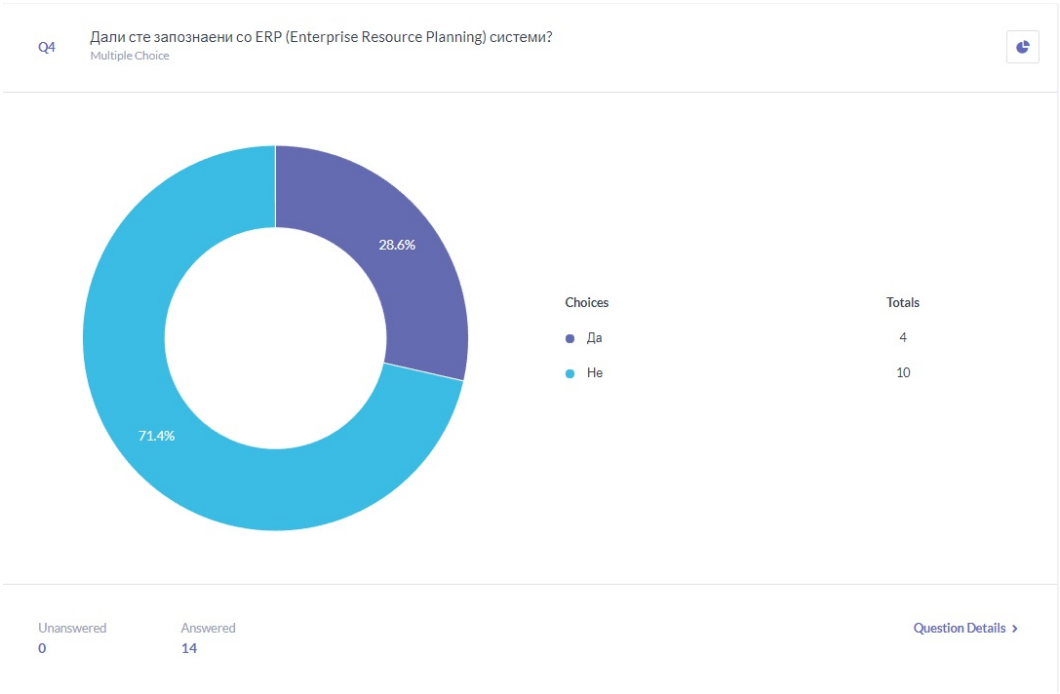

FIGURE 27: SURVEY RESULTS OF QUESTION 4

Information systems seem to be used in 9/14 cases, but only in limited modules.

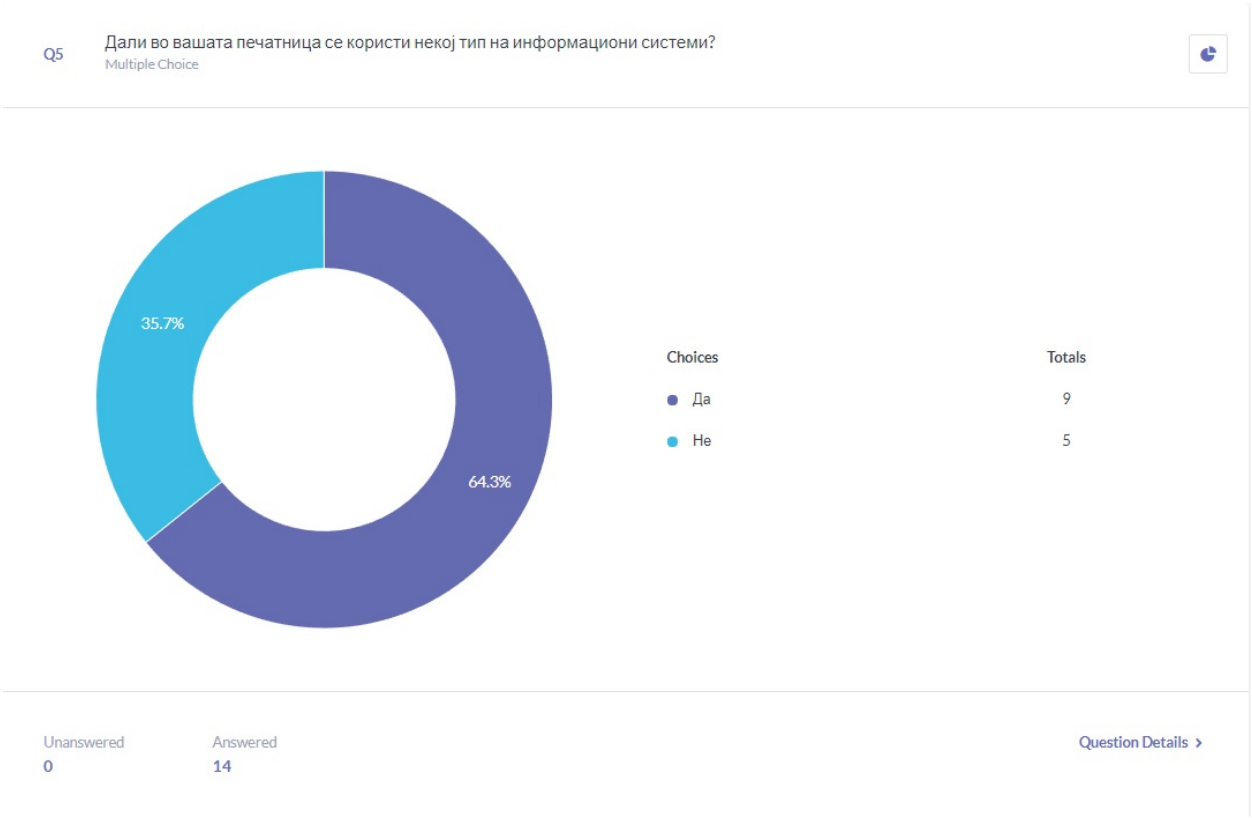

FIGURE 28: SURVEY RESULTS OF QUESTION 5

On the figure 30 we can observe the types of information systems that are being used by the printing companies surveyed. Most of them use a financial module for invoices etc. Also a lot of them have inventory system. Only 4 out of 14 firms answered not to have any of the systems listed.

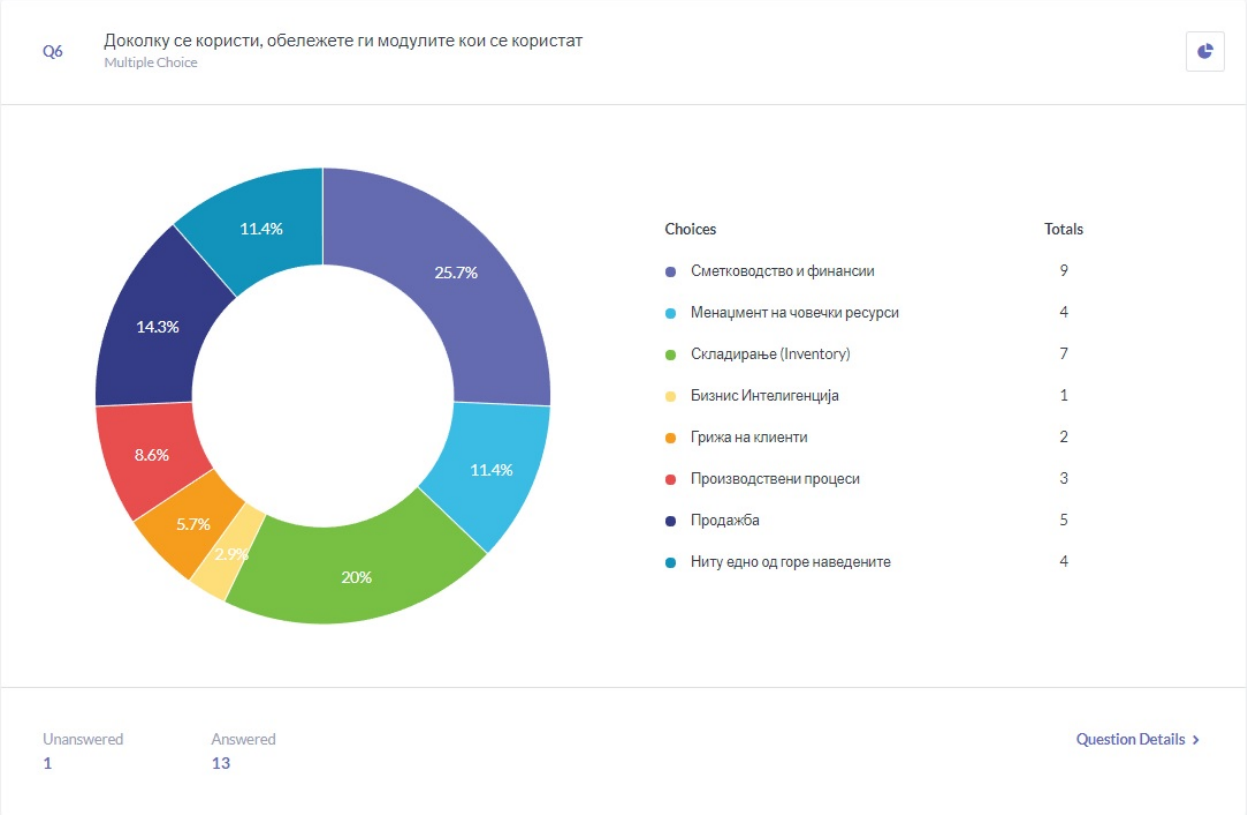

FIGURE 29: SURVEY RESULTS OF QUESTION 6

In order to determine the types of systems used, wheatear it is a desktop application, SaaS or a custom made software, the Question 7 showed that only one company uses custom made software and none of them uses SaaS. All of the printing companies answered that they use Desktop application. Today considered as outdated application.

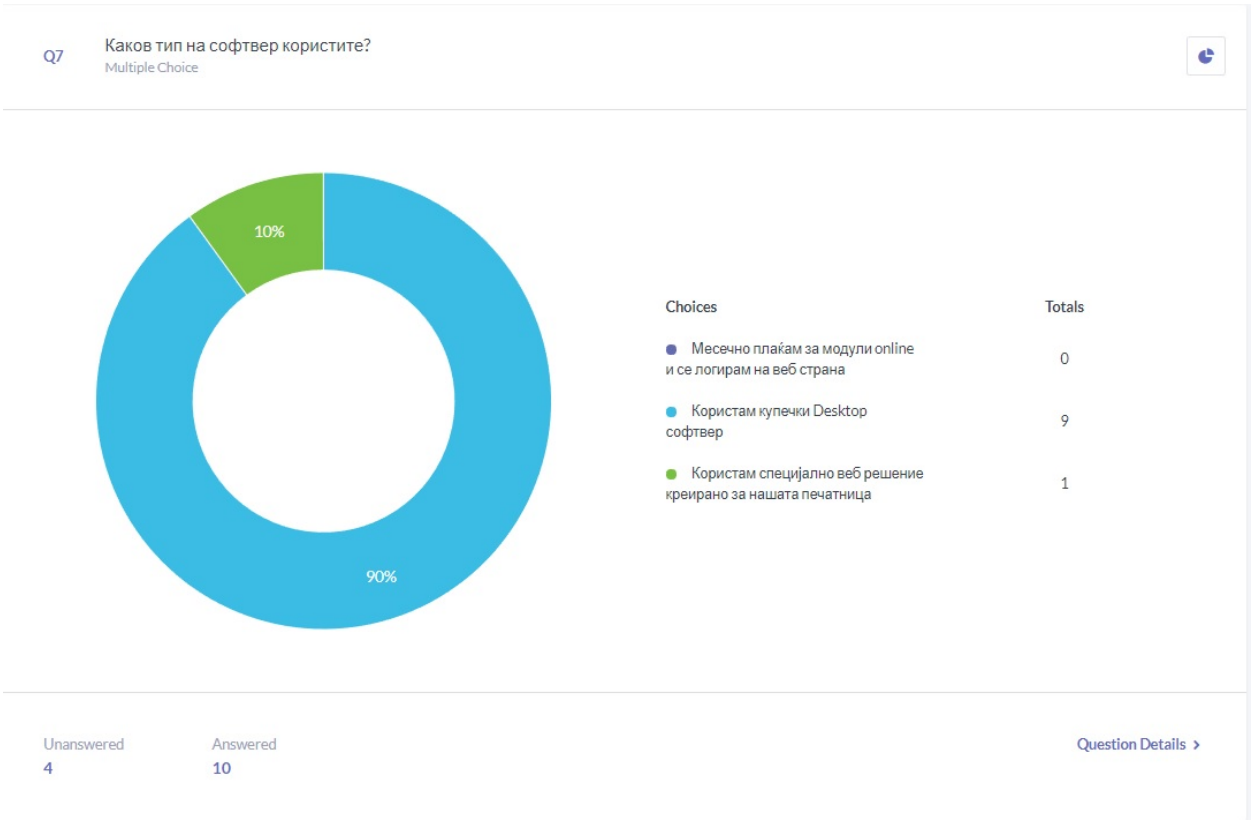

FIGURE 30: SURVEY RESULTS OF QUESTION 7

Printing companies reported to use the Pantheon software mostly.

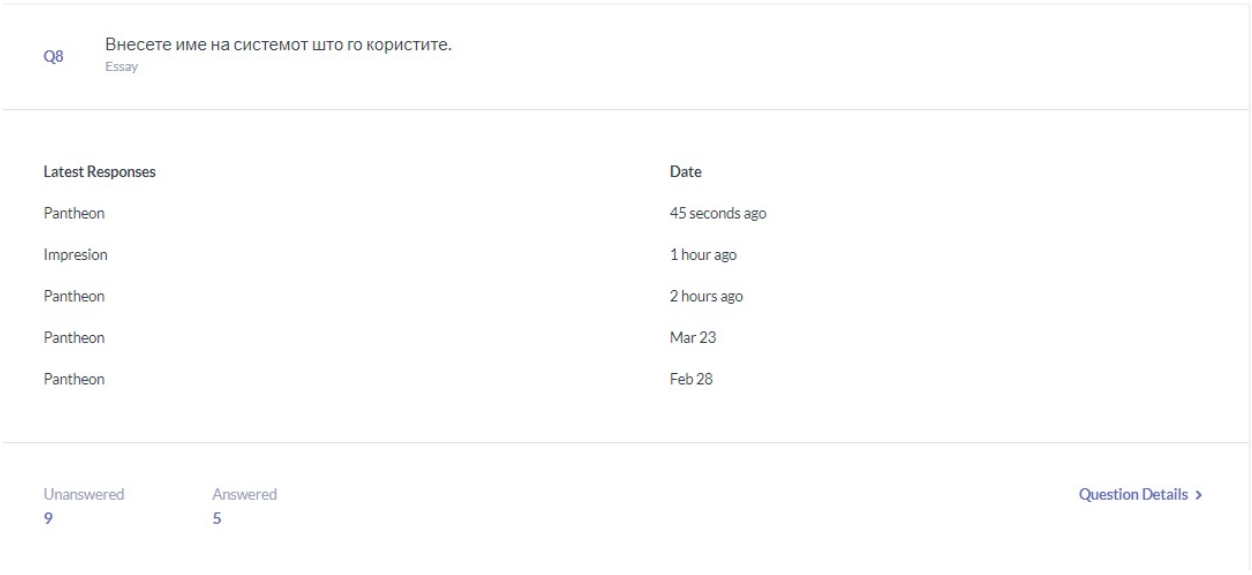

FIGURE 31: SURVEY RESULTS OF QUESTION 8

From question 9 we can observe high dissatisfaction of the software they use. From scale 1 to 10 the average answer is 4.1.

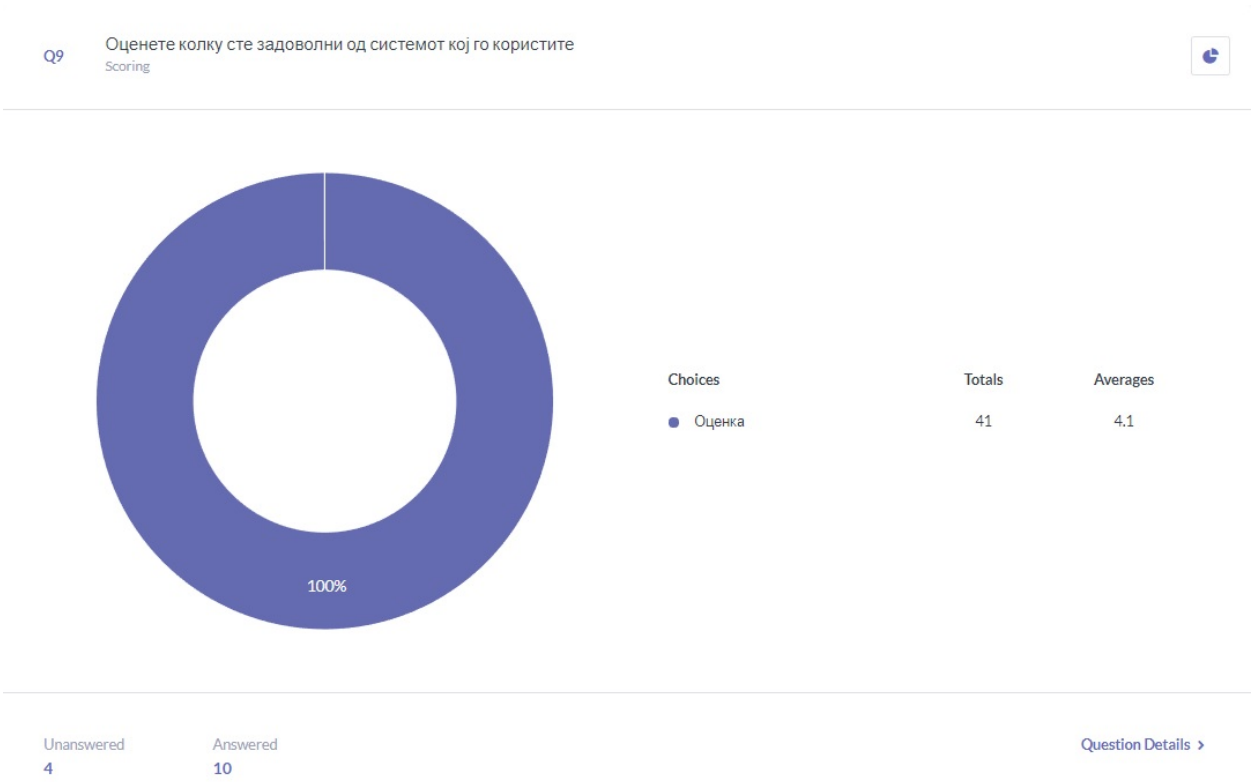

FIGURE 32: SURVEY RESULTS OF QUESTION 9

Only a few companies answered how much are they willing to pay for any ERP software on a monthly bases. And the average answer is 567.5 euros.

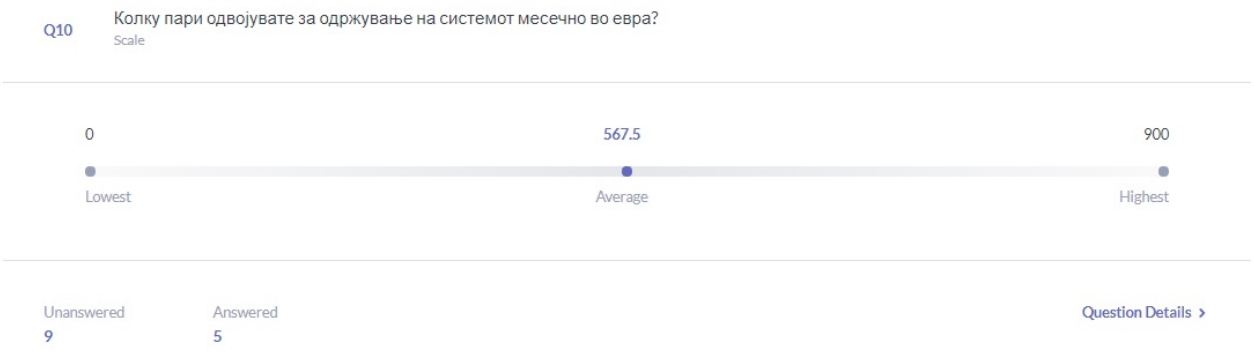

FIGURE 33: SURVEY RESULTS OF QUESTION 10

Three firms reported problems with the implementation of Information systems in their companies. One reported limited amount of licenses. Adjustment of the company to the software, instead of the software to the company. Inability to adjust the application to the printing processes. Low IT knowledge of the staff.

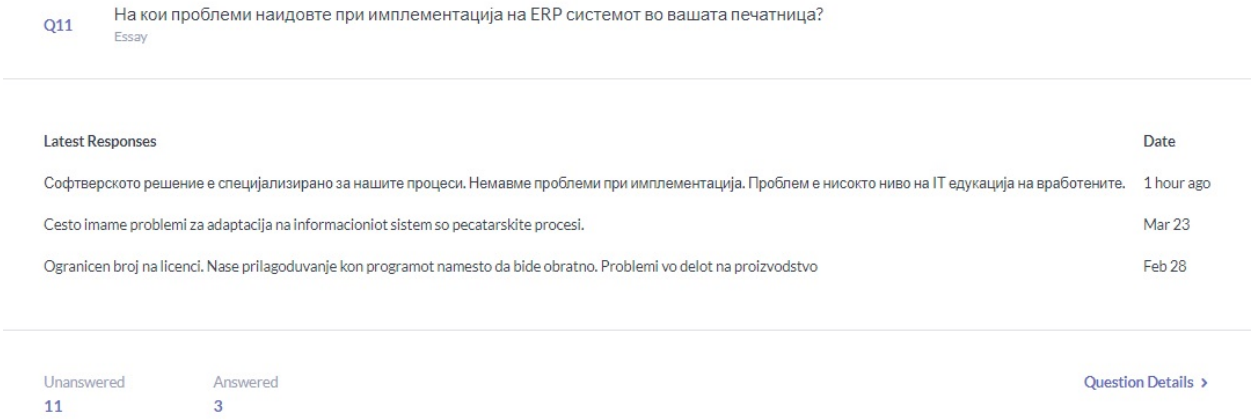

FIGURE 34: SURVEY RESULTS OF QUESTION 11

The average price that firms want to pay monthly for any ERP module they require is 158.33 euros.

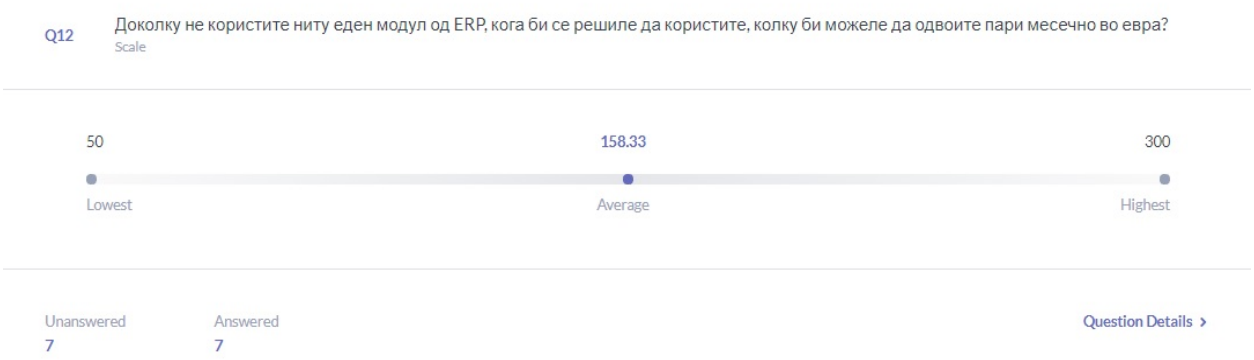

FIGURE 35: SURVEY RESULTS OF QUESTION 12

The final question is telling us that printing companies in Macedonia are not informed enough of the advantages of ERP systems. Ten out of fourteen reported not to be enough informed about these systems and how they can improve business processes in the company.

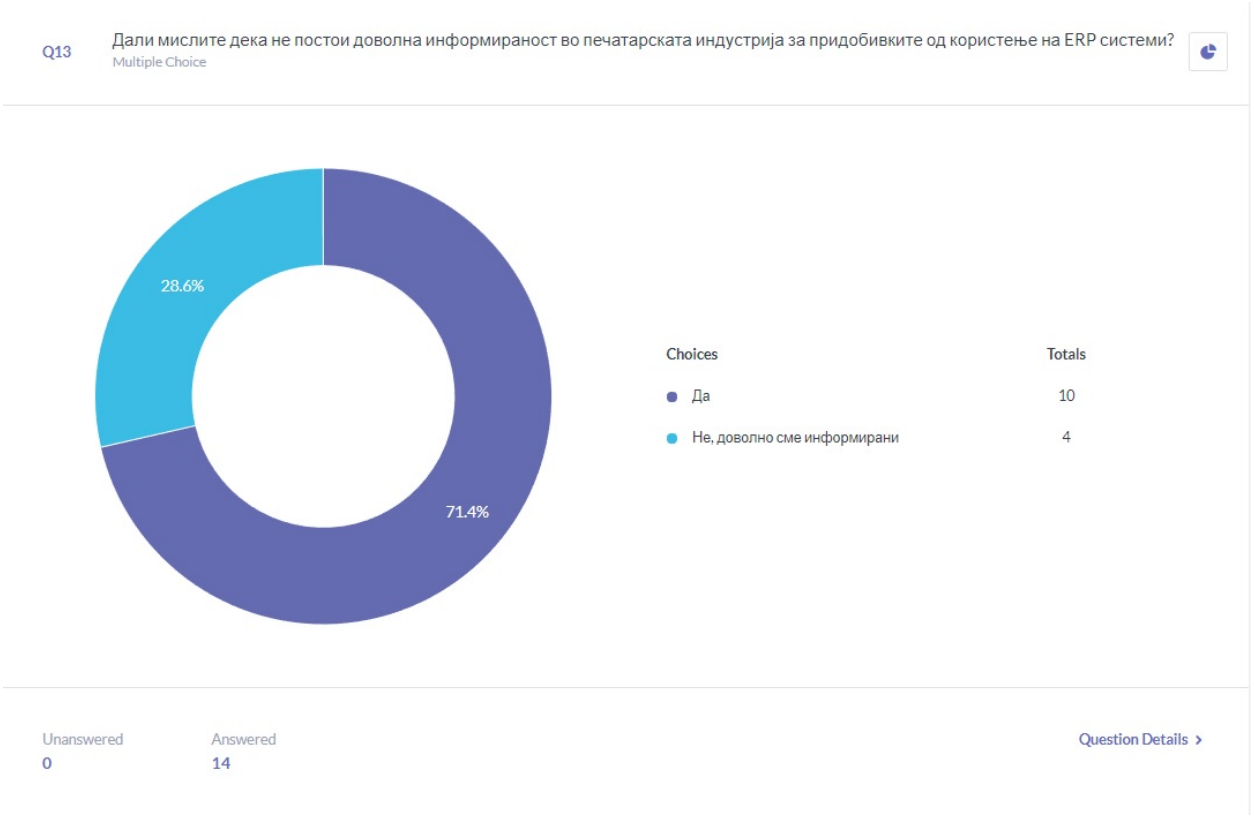

FIGURE 36: SURVEY RESULTS OF QUESTION 13

8. Conclusion

Macedonia is without a doubt a western oriented country. And society and all companies lean to adopt and implement technologies that will make them up to date or compatible to compete in that environment. Since the European Union is the largest market for export to Macedonian companies, information technologies have found their place in most of the export-oriented firms.

Having targeted the printing industry in Macedonia in this theses, we can conclude that ERP systems, as a whole set of modules that help businesses improve processes in the companies, haven't found their place yet in this industry. Most of the firms only use partial information systems, like financial system, and are not ready to implement ERP system. When I asked all the printing companies in Macedonia to report use of information systems, only one reported to have specifically custom made ERP software, and the rest only used partial modules. Most of the reasons are obvious. Primarily it is the knowledge. They are mostly not informed about ERP systems. Other reasons is the price that has to be paid, the undereducated staff to work with such technology, the low ability to grow and compete in the business environment etc.

When conducting the proposal for this thesis I brought two hypothesis. I can say that both of them have been partly confirmed. My second hypothesis that lack of education in the information technologies of the staff would present an obstacle in implementing ERP systems and working with such has been confirmed in most cases. Yet, as I have proposed in my first hypothesis, very few companies have managed to implement at least a few modules of ERP system and it has improved business processes.

Companies that have any information system, usually have complaints about it, like the implementation process, the efficiency, or the price.

Macedonian printing industry is able to compete with the quality and the prices of products with developed countries. But, certain process perfection is limited mostly due to inability to implement advanced ERP software and automate internal processes.

Nevertheless, this is a small country and certain development in the companies is often slow and limiting. Companies in Macedonia need to find a way to be up to date and in competition with the developed world and use the local highly skilled IT professionals to help them undergo an IT improvement process with a low cost.

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