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Effects of Emerging Digital Technologies on the Development of Offset Printing in South West Nigeria

Noah Adegoke Adeyeye, Sunday Roberts Ogunduyile (Ph.D), Emmanuel Bankole Oladumiye (Ph.D)
Department of Industrial Design
Federal University of Technology, Akure, Nigeria
Akure, Nigeria.

Abstract:- Consistent innovations and agitation for new technologies have become usual experiences in different phases of the global manufacturing sector. These continuous technologies are geared towards new and faster methods of production, better performance in meeting and satisfying customer demands, such as scheduled delivery times, minimizing costs, consideration of quality parameters, establishing means of maintaining efficient and effective production, and sustainability in a competitive market. In peculiar sectors, the emergence of different phases of digital technology is remarkable. The sectorial offset printing industry is not left out as the experience is very much pronounced in the means and ways involved in the production of printed materials. The aim of the study is to identify the categories of process adoption in the offset printing industry, examine the level of adoption of each category, and investigate the impact of digital printing on the development of offset printing in South West Nigeria, with a view to providing significant information for sustainability in future competitive printing market. The objectives of the study are to identify the categories of process adoption in the offset printing industry, examine the level of adoption of each category, and investigate the impact of digital printing on the development of offset printing in South West Nigeria. The sample sizes for the study areas were selected at random from registered offset printing establishments as follow: Somolu-274, Akure-36 and Ibadan-192. Both primary and secondary data were employed. Survey design was adopted and the data were gathered through structured questionnaire and subjected to both descriptive and inferential statistical tools for analysis. The hypothesis derived was tested using chi-square tool. The significant relationship between the variables is indicated by x^2 (4) = 43.201, P = 0.000. The study revealed remarkable developments in all the offset printing firms under investigation. Positive influence was noticeable in the adoption of Computer-To-Plate (CTP) and Direct Image digital processes. However, greater percentage of offset printing firms still adopted only the old German technology while some others adopted digital printing as complementary process. Also, offset printers without digital complementary process confirmed that some volumes of large format, short-runs, Print-on-demand and personalized prints had been lost to digital printing firms outside the offset industry. The study recommended that printing firms still adopting only offset printing, with old technology machines, should embrace the new technological development trend so as not to be left behind in future competitive printing market.

Keywords:- *Process Category, Adoption, Computer-To-Plate, Direct Image, Digital Printing.*

I. INTRODUCTION

The use of technology to improve a wide variety of operations is the purpose of the ever increasing innovations and digital computerization. The entire world is fast becoming digital and the exercise of delay in the shift to digital processes will drastically affect competitiveness in the contemporary global market. According to b2cprint.com, technology is developing at a rapid pace and changing many established methods of accomplishing tasks and completing projects. Corroborating this fact, Leon and Leon, (2001) confirmed that computer technology is forever changing how we all live, work, relax and communicate. Tuman (2019), affirmed that over the past couple of years, there have been significant advancements in technology, not only impacting our lives but also various industries.

The production of printed products, for instance, has increasingly changed from a craftsman's trade into industrial production with the objective of an automated unit without human labor force (Szentgyorgyvolgyi, 2008). Thompson (2014) affirmed that the last 20 years have seen more significant changes in the development of print processes than ever before. According to Thompson, (opcit) globalization of digital printing is hard to ignore and will certainly take a larger proportion of the printing works currently led by offset lithography, flexography and screen printing. However, complete shift from offset to digital printing has been greeted with reluctance in South West Nigeria. This is as a result of the predominance of offset printing for decades. The reluctant extent of offset printing firms hangs on records of durability of old mechanical German technology in use, low education that accommodates many employees, especially machine operators, market structure in the common demand for books, magazines, encouraging book binding and print finishing exercises. Confirming this experience, Makoetta (2015), quoting the

printers.com said the printing industry remained behind the times when it comes to digital printing, emphasizing that less than 5% of printing companies have actually installed the digital devices. Adshead (2013) submitted that publishers are now being forced to review their whole image and expand into new areas in order not to be left behind by this new digital era. Whereas, b2cprint.com opined that despite the fast pace of technological innovation, print and design businesses do not have to switch to purely digital processes overnight, they can instead integrate both digital and offset processes.

Offset is a printing technique involving the transferring of an image from a metal plate to a rubber blanket before being printed on the receiving media, usually paper (technopedia.com, 2016). It is the dominant industrial printing technique used for printing a wide range of products such as cards, stationery, leaflets, brochures, magazines and books (Champaneri Engineers, 2018). On the other hand, digital technologies are electronic tools, systems, devices and resources that generate, store or process data e.g. Social Media, online games, multimedia and mobile phones (education.vic.gov.au) while digital printing is a method of printing from a digital-based image directly to a variety of media (Whitbread 2009). It involves printing small-run jobs from desktop publishing and other digital sources using large-format and/or laser or inkjet printers. The areas of digital technology as they affect offset printing include: (1) Computer-to-plate (CTP) process, (2) Direct Image (DI) printing process and (3) Digital printing process. CTP device is a commercial printing process equipment that transfers text and graphics straight from a computer to a plate, a digital replacement for the manual, time consuming chemical processing that are performed when making plates from films (businessdictionary.com,). CTP is a stand-alone "off press" procedure, and the finished product (plate) must be mounted on the offset press.

Direct Imaging is the bridge between electronic prepress systems and true offset printing, allowing digital data to be sent directly to the printing press using non-photographic technology (Solution 3 Graphics, 2020). It is a four-color offset printing press ('on-press') without film, chemistry or removable plate. It is also referred to as computer-to-press (CTPs) or direct-to-press (DTPs) equipment. All the offset printing firms are struggling to procure the CTP equipment as it provides a bridge for overcoming the cumbersome techniques in traditional or manual processing involving exposure of plates to sunlight or the use of printing down frame, chemical development, among others, before mounting on the press for printing. Thus, possessing this equipment is the mindset of all the offset firms investigated. The direct image equipment is dominantly in use in offset presses. It is described as offset printing 'on-press' equipment. The printing plate is in-built and not removable. The CTP and DI are the state-of-the-art digital technologies in use in the offset printing industry to achieve high quality production with shortest possible delivery time for client's maximum satisfaction.

This study was conceived with the following research questions: (1) what are the categories of process adoption in the offset printing industry? (2) What are the levels of adoption of each category by offset practitioners? (3) What are the impacts of digital printing on the development of offset printing in South West Nigeria?

A study closely related to this study was titled '*Effect of the Digital Technology to the print production processes'*, authored by Szentgyorgyvolgyi in 2008. The objectives of the research are; to draw attention to the process design solutions applied in Hungarian print industry, to introduce and analyze digital workflow systems and to provide information on relevant standards and operational background. Survey was carried out among media companies in Hungary involving interviews and answers to the questions drawn. The questions were distributed to 72 printing companies. Responses were retrieved from 65 companies. From the results, conclusions were drawn that in Hungarian printing industry one part of the workflow is based on digital data for prepress with electronics used for measurement and process control. The integration of prepress and automation in related processes, except for finishing processes, have reached a certain maturity.

On the other hand, this current research is titled "*Effects of Emerging Digital Technologies on the Development of Offset Printing in South West Nigeria*". The objectives are to (1) identify the categories of process adoption in the offset printing industry in South West Nigeria, (2) examine the level of adoption of each category by offset practitioners, and (3) investigate the impacts of digital technologies on the development of offset printing in South West Nigeria. Survey was carried out among offset printing firms in three cities in South West Nigeria, involving interviews and answers to the questions drawn. The questions were distributed to 274 firms in Somolu, 36 firms in Akure, and 192 firms in Ibadan.

Results of the finding revealed that digital technology has been incorporated in two main areas of operation in offset printing namely Computer-To-Plate (CTP) procedure and Direct Image (DI) process. The third type of digital technology namely Digital Printing which involves sending images directly to the printer using digital files such as large format printing, is utilized as complementary process only by limited number of offset firms. The essence of this study is to probe into the influence of digital technology on offset printing practice, and confirm or debunk the notion that digital printing is taking over offset printing in the next few years when the state-of-the-art hybrid technology is combining conventional processes (offset, digital, flexography, and others) for the achievement of various printing goals in a single printing unit.

II. METHODS

A. Study Area

The study was focused on three areas from three states in South West Nigeria. South West Nigeria comprises of six states namely Lagos, Ogun, Oyo, Osun, Ondo and Ekiti. Somolu in Lagos State and Ibadan in Oyo State were chosen on the basis of commercial status and population density of printing to represent highly commercial cities from the earlier created States of Lagos, Oyo and Ogun while Akure in Ondo State was chosen to represent the commercial status of the last created States of Ondo, Ekiti and Osun.

B. Data Collection

Both primary and secondary data were employed. The primary data were obtained from field survey involving the Chief Executive of offset printing firms as respondents while the secondary data were sourced from textbooks, works of past researchers, journals and the internet. The data were collected from the study areas adopting survey design which involved questionnaire schedule as the research instrument. Questionnaire is the most affordable way to gather quantitative data, ensuring a practical, quick way to get results and allows easy analysis of the results (Debois, 2019). The questionnaire addressed issues raised in the research hypothesis, research questions and objectives of the study. A 5-scale, Likert scale (Mcheod, 2019), ranging from strongly Disagree to strongly Agree (1= strongly disagree (SD), (2) = Disagree (D), (3) = undecided (U), (4) = Agree (A) and (5) = strongly agree (SA)) was used. The sample size in each of the three study areas is presented as follows: Somolu-274 firms, Akure-36 firms and Ibadan-192 firms. The distribution and administration of the questionnaire and collection of the responses from respondents were done by hand, involving the researcher visiting each city with a research assistant (employed) who was a native of respective study area. Data collected were analyzed with both descriptive and inferential statistics using the software Statistical Package for Social Sciences (SPSS).

C. Data Analysis

The research objectives were analyzed using descriptive statistics in form of frequency distribution tables, percentages and inferential statistics in form of Chi-square. Specifically, research objective 1 (identify the categories of process adoption in the offset printing industry) relating to variable 1 was analyzed with tabular identification. Research objective 2 (examine the level of adoption of the process categories by practitioners), was presented and analyzed with tabular representation, while research objective 3 involved variables 3-13 with research hypothesis that states "there is no significant relationship between digital printing and the development of offset printing". The hypothesis postulated was tested using chi-square at 0.05 level of significance. Results from the implementation of the objectives, research questions and hypothesis showed that; (1) there had been pronounced developments in the offset printing industry with the emergence of two digital technologies namely computer-to-plate and direct image facilities, (2) majority of offset printing firms are still limited to the old offset printing machines and (3) digital printing firms outside the offset industry are taking some volumes in terms of short runs and large format prints from offset firms.

III. RESULTS AND DISCUSSIONS

From table 1, the first process coded as **'O only'** involves the traditional improvisation through which the plate is exposed through laser film to sunlight or through a printing-down frame and then developed manually with plate etch or developing solution.

O+CTP, the second process is the process involving offset with digital plate making machine. This process is generally referred to as computer-to-plate (CTP) because the digital file produced in the computer system is directly sent to the plate making machine for exposure and development of the plate, ready for the press without any manual operation.

TABLE I. PRESENTATION OF THE CATEGORIES OF PROCESS ADOPTION

S/N	Categories of Process adoption	Code
1	Offset with traditional plate making process only (for long runs)	O only
2	Offset with digital plate making machine (CTP)	O + CTP
3	Offset with Direct Image (Digital) for Short runs/P.O.D.	O + DI
4	Offset with Digital Large Format printing, short runs/P.O.D.	O + LF
5	Offset with internet/web printing	O + Web
6	Offset, Digital and Conventional Processes (Hybrid Printing)	O + Hyb

Source: Author's Field Work, 2019

'O+DI': this is the third process that incorporates offset printing (long run) with Direct Image equipment for Short runs/Print-On-Demand (P.O.D). Direct Image process has an in-built plate making device that processes the plate automatically inside the machine. The DI digital printing machine is a complete press on its own, processing successive plates according to the digital file from the computer. It is a waterless device and may be termed dry (offset) printing. This implies that two different types of job could be handled at the same time in that, the limited number of copies will be done with the Direct Image machine while the large number will be produced with long-run offset printing machine. P.O.D is an abbreviation for Print-on-Demand. It is a printing process in which book copies or other documents are not printed until the company receives an order, allowing prints of single or small quantities (Kleper, 2000).

'**O+LF**' is the fourth process category, presenting the opportunity of handling medium size, long-run jobs with offset machine and large size short-run jobs with large format digital machine as complementary process. Unlike the DI process which is termed 'dry offset', large format machine is a different entity, and not related to offset as it is purely a digital process.

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'**O+Web**': Some printing firms are involved in the production of printed materials through the internet. The printed materials can be accessed through the internet. This is also referred to as web printing.

'**O+Hyb**': this is Hybrid printing, the technology of combining offset with digital and with other conventional processes such as flexography, letterpress, among others. This has not been adopted in any of the study areas.

Variable 2 presents the level of adoption of the different categories of offset and digital printing possibilities in the offset printing industry as shown in table 2.

TABLE II. PRESENTATION OF DATA ON THE LEVEL OF PROCESS CATEGORY ADOPTION

Code	**Level of adoption by firms**		
	Somolu	**Akure**	**Ibadan**
O only	120 (44%)	19 (53%)	78 (41%)
O+CTP	58 (21%)	3 (8%)	44 (23%)
O+DI	77 (28%)	12 (33%)	56 (29%)
O+LF	14 (5%)	2 (6%)	12 (6%)
O+Web	5 (2%)	0 (0%)	2 (1%)
O+Hyb.	0 (0%)	0 (0%)	0 (0%)
Total	**274 (100%)**	**36 (100%)**	**192 (100%)**

A. Discussion on the level of process category adoption

In variable 2, as shown in table 2, the number of firms that are still adopting traditional process, according to responses from respondents, are as follow: Somolu 120 (44%), Akure 19 (53%) and Ibadan 78 (41%). The second process category is the process involving offset with digital plate making machine (CTP). With this process, Somolu had 58 (21%) firms, Akure had 3 (8%) and Ibadan had 44 (23%). The third process coded as '**O+DI**' incorporates offset printing (long run) with Direct Image Digital printing (short runs/P.O.D). Responses from respondents showed 77 (28%) for Somolu, 12 (33%) for Akure and 56 (29%) for Ibadan. The fourth process coded '**O+LF**' presents the opportunity of handling medium size long-run jobs with offset machine and large size short-run jobs with large format digital machine as complementary process. 14 (5%) firms from Somolu, 2 (6%) from Akure and 12 (6%) from Ibadan were involved in the combination process. There are some printing firms involved in the production of printed materials through the internet coded as '**O+Web**'. The number of firms involved in this method are not many. Only 5 (2%) firms responded in Somolu among the firms visited, 0 (0%) in Akure and only 2 (1%) in Ibadan. However, none of the offset printing firms investigated in all the study areas is involved in hybrid printing ('O+Hyb') as responses recorded are zero all through.

TABLE III. SUMMARY OF DATA ON LEVEL OF PROCESS ADOPTION

Code	**Adoption**	**%**
O only	217 firms	43
O+CTP	105 firms	21
O+DI	145 firms	29
O+LF	28 firms	5.6
O+Web	7 firms	1.4
O+Hyb.	0 firm	0
Total	**502 firms**	**100%**

Source: Author's Field Work, 2019

From table 3, 217 firms are the offset printers that stick to the traditional method. The number is the highest in all the categories, having about 43% of all the offset firms under investigation. Firms in this category believe that digital printing machines are not as durable as offset printing machines, and are not ready to dabble into any thin digital.

Digital Plate making machine (CTP) is gaining ground in the offset printing industry. It is confirmed from this study that digital plate making machine has replaced the traditional means of exposing plate and development by hand. Although the number currently in the printing industry is relatively small, the influx into the industry is increasing every day. Presently, 105 (21%) of all the firms under investigation are already using the machine. It has the advantage of overcoming the bottle-neck posed by manual exposure to sunlight and development by hand. The digital plate making machine minimizes waste in the quantity of developer/plate etch, fixing solution, employing the appropriate time for exposure. Out of the firms investigated, 145 (29%) firms are using this machine. Printing jobs that demand for long impressions are done on the offset press ('O only' category) while jobs demanding short impressions will be run on the DI machine. This enhances the opportunity of taking two different jobs at the same time and meeting the delivery time scheduled. Thus, digital technology has been developed to enhance the step by step operations in offset printing with the instances of the CTP and the DI machines. If the categories of these two emerging technologies, are added together (that is, 145+105), the result which is 250, is greater than the category of firms that are only on traditional process which is 217. Thus, it can be concluded that these two emerging technologies have significant influence on the practice of offset printing practice. Complementary advantage goes for the digital large format printing more especially that large-size jobs that cannot be run with offset machines, will be possible with the large format printing device. So, instead of rejecting large-size jobs, the offset printer will receive such jobs and run them on the large format digital press. The number of firms adopting this practice among the firms investigated is 28 i.e. 5.6%. However, since the large format digital printing is not built for the enhancement of offset printing process, it is considered as a parallel process which the society is claiming will take over offset printing within the next few years.

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Furthermore, some firms decided to present their printed materials through the internet for public accessibility. This is termed internet/web printing. The number of firms involved, among the firms investigated is 7 (1.4 %). Hybrid printing is yet to be practiced in all the study areas as the responses recorded zero for all the centers.

B. Variables for Objective 3(3 – 12)

V3: Digital printing firms (e.g. large format) are increasing in the printing market but still limited in number compared to offset printing firms.

V4: Digital printing (large format) will replace offset printing within the next 20 years.

V5: More than 20% of offset customers had been lost to digital printing firms

V6: Digital printing can only complement offset in the printing industry.

V7**:** Large format digital machines are not as durable as offset printing machines.

V8**:** Graphic Designers in offset firms are capable of manipulating digital files.

V9**:** Offset firms are already using digitalized plate making process

V10**:** Offset firms are already adopting Direct Image printing for short runs.

V11**:** Hybrid technology combines digital with offset and other conventional processes.

V12: Digitalization will soon become a common phenomenon in all processes and each will only be referred to on the basis of substrate e.g. plate, paper, vinyl (e.g. large format), led screen (internet), etc.

TABLE IV. PRESENTATION OF DATA ON IMPACT OF DIGITAL PRINTING ON THE OFFSET INDUSTRY (OBJECTIVE 3)

	Somolu – 274					**Akure – 36**					**Ibadan – 192**				
Variables	**SD**	**D**	**U**	**A**	**SA**	**SD**	**D**	**U**	**A**	**SA**	**SD**	**D**	**U**	**A**	**SA**
V3	0 0%	0 0%	0 0%	120 44%	154 56%	0 0%	0 0%	0 0%	12 33 %	24 67 %	0 0%	0 0%	0 0%	87 45%	105 55%
V4	78 28.5 %	102 37.2 %	67 24.4 %	20 7.3 %	7 2.6 %	10 28 %	16 44 %	5 14%	3 8%	2 6%	60 31 %	88 46%	30 16%	10 5%	4 2%
V5	98 36%	108 39%	68 25%	0 0%	0 0%	13 36 %	17 47 %	6 17%	0 0%	0 0%	67 35 %	85 44%	40 21%	0 0%	0 0%
V6	0 0%	6 2%	78 28%	109 40%	81 30%	0 0%	2 6%	8 22%	16 44 %	10 28 %	0 0%	4 2%	56 29%	78 41%	64 28%
V7	0 0%	0 0%	0 0%	182 66%	92 34%	0 0%	0 0%	0 0%	20 56 %	16 44 %	0 0%	0 0%	0 0%	117 61%	75 39%
V8	0 0%	0 0%	18 7%	160 58%	96 35%	0 0%	0 0%	0 0%	22 61 %	14 39 %	0 0%	0 0%	0 0%	106 55%	86 45%
V9	0 0%	0 0%	0 0%	104 38%	170 62%	0 0%	0 0%	0 0%	16 44 %	20 56 %	0 0%	0 0%	0 0%	76 40%	116 60%
V10	0 0%	0 0%	0 0%	73 27%	201 73%	0 0%	0 0%	0 0%	7 19 %	29 81 %	0 0%	0 0%	0 0%	35 18%	157 82%
V11	0 0%	0 0%	85 31%	120 44%	69 25%	0 0%	0 0%	10 28%	18 50 %	8 22 %	0 0%	0 0%	62 32%	73 38%	57 30%
V12	0 0%	7 2%	35 13%	150 55%	82 30%	0 0%	2 6%	8 22%	16 44 %	10 28 %	0 0%	4 2.18 %	20 10.4 %	100 52.1 %	68 35.4 %

Source: Author's Field Work, 2019

C. Discussion on impact of digital printing on the development of offset printing in South West Nigeria

Objective 3 The first variable in this objective (V3) was designed as 'Digital printing firms (e.g. large format) are increasing in the printing market but still limited in number compared to offset printing firms' to know whether actually digital printing has overtaken offset printing in the printing market. Responses from the respondents affirmed that although digital printing establishments are increasing but still very far below the number of offset printing establishments. The responses are as follow. From Somolu, responses agreed and strongly agreed. 120 firms (44%) agreed and 154 (56%) strongly agreed. No firm was undecided or disagreed or strongly disagreed. Akure followed the same pattern in their responses. For instance, no firm strongly disagreed, none disagreed or undecided. 12 firms (33%) agreed and 24 firms (67%) strongly agreed. Ibadan was not left out. 87 firms (45%) agreed and 105(55%) strongly agreed.

Variable 4 (V4) presented the general notion of the society captioned as "Digital printing will replace offset within the next 20 years". To this variable, all the options had scores. In Somolu 78 firms (28.5%) strongly disagreed, 102(37.2%) firms disagreed while 67(24.4%) firms were undecided. However, 20(7.3%) firms agreed to the variable and 7(2.6%) strongly agreed. Akure recorded 10(28%) firms strongly disagreeing, 16 firms (44%) disagreeing while 5 firms (14%) were undecided. Only 3 firms i.e. 8% agreed and 2 firms representing 6% strongly agreed. Ibadan has 60 firms or 31% strongly disagreeing, 88(46%) disagreeing and 30 firms or 16% undecided. Only 10 firms (5%) and 4 firms 2% agreed and strongly agreed respectively.

In order to deduce the extent of the negative effect of digital printing on offset printing, variable 5 (V5) was presented. The variable reads "more than 20% of offset customers had been lost to digital printing firms". In this variable, printing practitioners kicked against the notion and responses were either strongly disagree, disagree or undecided. No firm agreed or strongly agreed. In Somolu, the total of 98 firms (36%) strongly disagreed, 108 firms (39%) disagreed and 68 firms (25%) were undecided. From Akure, 13 firms (36%) strongly disagreed, 17 firms (47%) disagreed and 6 firms (17%) were undecided. Ibadan had 67 (35%) records of strongly disagreed, 85 firms (44%) disagreed and 40 firms (21%) undecided.

A complementary function of digital to offset was predicted and presented to printing firms in variable 6 (V6). In the reaction of the printing firms, in all the study areas, no firm scored strongly disagree. But in Somolu, 6 firms (2%) disagreed, 78 firms (28%) were undecided while 109 firms (40%) and 81 firms (30%) agreed and strongly agreed respectively. From the records in Akure, 2 firms (6%) disagreed, 8 firms (22%) were undecided while 16 firms (44%) agreed and 10 firms (28%) strongly agreed. Ibadan scored 4 firms (2%) for disagree, 56 firms (29%) for undecided while 78 (41%) and 64 (28%) agreed and strongly agreed respectively.

During the pilot survey, some offset firms vowed not to go into digital printing for the singular reason of durability. The complaint was that digital printing machines are not as durable, more especially, that capable engineers are not within easy reach. Examples of digital machines that had broken down were sighted. Majority of the printing firms therefore scored columns of 'agree' and strongly agree for variable 7 (V7). The scores from Somolu recorded 182 firms (66%) for agree and 92 firms (34%) for strongly agree. Akure had a record of 20 firms (56%) for 'agree' and 16 firms (44%) for strongly agree, while Ibadan registered 117 firms (61%) and 75 firms (39%) for agree and strongly agree respectively.

In order to assess the value placed on graphic designers in terms of reliance and capability across the different offset printing firms, variable 8 (V8) was coined to receive the knowledge of printing executives as to whether they can go into digital printing even with the current graphic designers in their offices or not. Most of the printing firms supported the notion. From Somolu, only 18 firms (7%) were undecided. 160(58%) and 96(35%) firms recorded agree and strongly agree options respectively. Akure firms had no response for undecided. 22 firms (61%) and 14 firms (39%) recorded agree and strongly agreed respectively. Ibadan also had no record for undecided. 106 firms, i.e. 55% scored agree while 86 firms (45%) scored strongly agree.

The phrase 'offset firms are already using digitalized plate making process' was presented in variable 9(V9) to confirm the adoption in the industry. To this phrase, all the firms registered their scores for agree and strongly agree. Firms in Somolu, 274 in number, registered 104(38%) for agree and 170(62%) for strongly agree. Akure had 20 scores (56%) for agree and 16 scores (44%) for strongly agree. Ibadan registered 76 scores (40%) for agree and 116 (60%) scores for strongly agree.

Basically, offset process is better for long impressions i.e. long runs more especially that the more the number of impressions, the lower the unit price of the item printed. Direct Image digital process does not favor long runs, and the unit price runs throughout the number of impressions. To variable 10 (V10) respondents assented to the variable designed as "offset firms are already adopting direct image printing for short runs". The respondents signified their support for agree and strongly agree in all the study areas. In Somolu, 73 firms ticked the column under agree and the rest firms 201(23%) ticked for strongly agree. Akure firms ticked 7 (19%) for agree and 29 (81%) ticked for strongly agree. Ibadan firms ticked 35 (18%) for agree and 157 (82%) for strongly agree.

Variable 11(V11) brought about hybrid technology, the act of combining digital with offset and other conventional processes to complete various assignments in a single flow of production. The scores registered showed that many firms in all the study areas were undecided. In Somolu 85 firms (31%) were undecided while 120 firms (44%) and 69 firms (25%) agreed and strongly agreed respectively. No firm strongly disagreed or disagree in Akure. 10 firms (28%) were

undecided while 18 firms (50%) agreed and 8(22%) strongly agreed. Also no firm strongly disagree or disagree. Ibadan had records for undecided 62 firms (3.2%) while 73(38%) and 57 (30%) firms agreed and strongly agreed respectively.

Prediction of digitalization becoming a common phenomenon in all processes was presented in variable 12 (V12) to examine the view of printing practitioners. None of the practitioners strongly disagreed in all the study areas. However at Somolu, 7 firms (2%) disagreed while 35 firms (13%) were undecided. 150 firms (55%) agreed and 82 firms (30%) strongly agreed. Akure had 2 firms (6%) that disagreed to the prediction while 8 firms (22%) were undecided. 16 firms (44%) agreed and 10(28%) strongly agreed. Ibadan recorded 4 firms (2.1%) that disagreed. 20 firms (10.4%) as undecided, while 100 firms, constituting 52.18% and 68 firms (35.4%) as agreed and strongly agree.

TABLE V. SUMMARY OF DATA ON IMPACT OF DIGITAL PRINTING ON THE DEVELOPMENT OF OFFSET PRINTING

Variables	SD	D	U	A	SA	Mean	Remark
V3	0 (0.0%)	0 (0.0%)	0 (0.0%)	219 (44.0%)	283 (56.0%)	4.6	SA
V4	14.8 (29.0%)	206 (41.0%)	102 (20.0%)	33 (70%)	13 (3.0%)	2.1	D
V5	178 (35.0%)	210 (42.0%)	114 (23.0%)	0 (0.0%)	0 (0.0%)	1.9	D
V6	0 (0.0%)	6 (1.0%)	142 (28.0%)	203 (40.0%)	155 (31.0%)	4.0	A
V7	0 (0.0%)	0 (0.0%)	0 (0.0%)	319 (64.0%)	183 (36.0%)	4.4	A
V8	0 (0.0%)	0 (0.0%)	18 (4.0%)	288 (57.0%)	196 (39.0%)	4.4	A
V9	0 (0.0%)	0 (0.0%)	0 (0.0%)	196 (39.0%)	306 (61.0%)	4.6	SA
V10	0 (0.0%)	0 (0.0%)	0 (0.0%)	115 (23.0%)	387 (77.0%)	4.8	SA
V11	0 (0.0%)	0 (0.0%)	157 (31.0%)	211 (42.0%)	134 (27.0%)	4.0	A
V12	0 (0.0%)	13 (3.0%)	63 (12.0%)	266 (53.0%)	160 (32.0%)	4.1	A

Source: Author's Field Work, 2019

Variable 3 sought to confirm the exponential increase in the establishment of digital printing. The responses were on agreement with the variable, as responses were tailored towards agree and strongly agree columns. 219(44.0%) responses were received for agree while a greater number of 283(56.0%) responses were received for strongly agree. There were no responses for strongly disagree, disagree and undecided. The mean value is 4.6 yielding the remark of SA (strongly agree). This confirms that digital printing is increasing appreciably but not yet up to the number of offset printing. Variable 4 preempted the possibility of digital printing replacing offset printing within the next 20 years. Reactions to this proposition were witnessed in all the variable measurements with each having scores. Strongly disagree had 148 (29.0%) scores, disagree had the highest number of scores of 206 (41.0%) while undecided had 102 (20.0%). 33 (7.0%) responses favored agree and the rest 13 (3.0%) favored strongly agree. The mean value is 2.1 giving a remark of D (disagree). With this result conclusion could be drawn that digital printing is not likely to replace offset printing within the next 20 years.

Variable 5 presented a confirmatory statement that "more than 20% of offset customers had been lost to digital printing". However, majority of the respondents disagreed with the statement. 178 (35.0%), strongly disagreed and 210 (42.0%) disagreed while 114 (23.0%) were undecided. No response for agree and strongly agree. The mean value therefore is 1.9 and the remark is D (disagree). From the view point of respondents that strongly disagreed and disagreed, the awareness that they have not lost their customers to the tune of 20% had enabled them to respond accordingly. However, those respondents that belong to the undecided group, had no doubt, lost some of their customers but cannot specify, whether or not, the percentage is up to or above 20%. In conclusion, it should be made clear here that the type of job and the number to be printed among other conditions will determine the type of process to be employed whether digital or offset. Not all jobs are suitable for both processes. The statement in variable 6 states that "Digital printing can only complement offset in the printing industry". This variable is affirming that offset printing will maintain its stability while digital will be in the supportive mode. Responses to the variable indicate that none of the respondents strongly disagreed. Only 6(1.0%) respondents disagreed while 142(28.0%) were undecided. The higher number of scores 203 (40.0%) was in favor of agree while the rest 155(31.0%) favored strongly agree. The mean value is 4.4 and the remark favored A (agree). Thus, the possibilities in digital and offset processes can be featured rightly if opinions are focused towards the complementing view and not on the view of comparison.

During the pilot survey conducted, some printers vowed never to go into digital printing for the main reason that digital machines are not as durable as the old refurbished mechanical offset printing machines. In order to gather the aggregate disposition of printers to the view, variable 7(V7) was presented to gather responses. The responses gathered showed that the whole of the respondents held the belief that digital machines are not as durable. The choices of respondents in the scores favored agree and strongly agreed columns. The agree column had 319 scores (64.0%) while the strongly agree column had 183 (36.0%) scores. The mean value for the variable is 4.4 and the remark is A (Agreed). From here, conclusion can be drawn that old and mechanical machines are more durable than the new and electronic digital machines.

Upheld in variable 8(V8) is the expectation that 'Graphic designers in offset firms are capable of manipulating digital files' was presented for scoring. Responses showed that there was none for strongly disagree and disagree. 18 responses (4.0%) were undecided and the rest 288(57.0%) and 196(39.0%) were for Agree and strongly agree respectively. These responses showed that graphic designers are capable of manipulating digital/computer files to plan the layout of all printing products whatever the conventional process involved. Opened up in variable 9(V9) is a new trend for investigation. This is about digitalization in the offset printing process. The variable has presented a view that "offset firms are already using digitalized plate making process'. To this view, responses were allocated only to Agree and strongly agree options. There was no response for strongly disagree, disagree and undecided. 196(39.0%) and 306(61.0%) scores were allocated in Agree and Strongly Agree columns respectively. The mean value is 4.6 and the remark is strongly agree. This entails that digital technology has become applicable to different steps in the offset process notably in the direct image and plate making techniques. The number of offset firms that are using direct image process are already many in the offset printing industry. Responses to variable 10 (V10) showed that 115 respondents (23.0%) scored Agree while 397(77.0%) scored strongly agree. There were no scores for strongly disagree, disagree and undecided. The mean value is 4.8 with SA (strongly agree) as remark. Literature reviews revealed that Direct Image (Digital) printing is a process that creates and utilizes a stationary in-built printing plate within the press itself as against the preparation of plate outside the press in wet offset.

Variable 11 sets to investigate the awareness of local printers about hybrid technology, the latest innovation in the technology of printing. Responses showed that 157(31.0%) were not aware as they were undecided. But 211(42.0%) respondents agreed while 134(27.0%) strongly agreed. The aggregate mean value is 4.0 for a remark of A (agree). Thus, latest development in printing technology is geared towards combining rather than comparing processes for a wholesome and worthwhile industry.

Variable 12 sets to receive responses to the proposition that "Digitalization will soon become a common phenomenon in all printing processes and each process will only be referred to on the basis of substrate e.g. computer to plate, computer to paper, computer to flex/vinyl (as in large format), computer to screen (as in internet), etc. This preposition was greeted with diverse options except for strongly disagree that recorded 0 (zero)/0.0%. Respondents that disagreed numbered up to 13(3.0%). Undecided were 63(12.0%) while 266(53.0%) and 160(32.0%) were for Agree and strongly agree respectively. The average mean is 4.1 and the overall remark is A (agree). This result indicates that 426(85.0%) of the respondents were in agreement with the proposition. Therefore, the proposition holds that digitization will soon become a common phenomenon in all printing processes and each process will only be referred to on the basis of substrate e.g. computer-to-plate (CTP), computer-to-paper (CTPp), computer-to-flex (CTF), computer-to-screen/internet (CTS), etc.

IV. CONCLUSIONS

In this study, three phases of emerging digital technologies have been identified. These are CTP, DI and Digital Printing. Both the CTP and DI are digital procedures but parts of the offset process and have contributed immensely to the development of the offset printing industry, providing a faster, easier and waste minimization opportunities in platemaking and direct image short-run procedures. The third emerging digital technology (digital/large format printing) has adversely affected the development of offset printing by taking away some volumes in terms of short-runs, print-on-demand, personalized and large format printing. This third aspect has brought about the high significant relationship in the chi-square result of the hypothesis tested. From the findings, it is established that offset printing firms have not lost up to 20% of their customers to digital printing firms. It could be accepted, on the basis of proofs received from respondents in this study, that digital printing would not replace offset printing within the next 20 years. It is also confirmed in this study that the type of job determines the type of process to be employed. Long-runs (large quantities) are suitable for offset printing while short-runs (small quantities) and large format printings are suitable for digital printing. It could be stated therefore that offset and digital printing processes are moving in parallel velocities in the market scene, and neither process can replace the other. The mindset of practitioners should be focused on hybrid printing, their meeting point, where offset, digital and more conventional processes would be integrated into a single printing unit rather than comparing printing processes.

Responses confirmed that digital printing equipment are not as durable, and competent engineers to maintain them are not readily available. This phenomenon discourages some offset printers from shifting to digital printing.

With the result of these findings, conclusions could be drawn that although digital printing firms are increasing but not yet as large in number compared to offset printing firms. Volumes of offset printing may be decreasing as digital printing will take some. However, it is predicted that offset

printing will still continue to be the best technology used for large quantity of prints before the full integration of conventional processes by the hybrid technology.

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APPENDIX A

HYPOTHESIS TESTING

Hypothesis 1

TABLE VI. CHI SQUARE TESTS

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	43.201[a]	4	.000
Likelihood Ratio	44.373	4	.000
Linear-by-Linear Association	37.683	1	.000
N of Valid Cases	371		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 24.43.

Hypothesis 1 states that 'there is no significant relationship between the impact of digital printing and the development of offset printing in South West Nigeria'. The chi-square result, x^2 (4) = 43.201, P = 0.000, shows that there is a high significant relationship between digital printing (as in large format printing) and the development of offset printing. The reason for this significant relationship is because large format printing firms are taking some volumes of prints from offset firms and also offset firms that adopted large format printing as complementary process, have more chances to record higher productivity, profitability and meet scheduled delivery times better than those who restricted their practice to only offset process.