

A STUDY OF INFORMATION SYSTEM DESIGNS USED BY SUCCESSFUL YOUNG AUSTRALIAN IT ENTREPRENEURS

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ABSTRACT: The rapid rate of technological change characterised by shorting product cycles and changing standards can have significant impacts upon small and medium-sized enterprises (SME's). This is even more critical for companies operating in the ICT industry. This study examines five Australian SME's who operate in the ICT industry focusing on the information systems which support their operations.

INTRODUCTION

Organizations around the world rely on information systems which are appropriate to the needs of their organizational structure. The importance of ensuring the best possible usage of information technology has been underlined as investments have increased, causing greater internal and external impacts [Ear89]. The benefits of ensuring that the organizational structure and the information systems which support the organizational structure achieve optimal alignment became apparent when companies realized their competitors were building significant competitive advantages through the use of effective information systems [PM85]. Through an examination of five successful Australian ICT companies owned by young entrepreneurs, the differing requirements and defining characteristics of each company's information systems are discussed to inform other entrepreneurs of the benefits a well suited information system can provide to a business.

Before moving on to discuss Mintzberg's organizational structures and co-ordination mechanisms it is important to understand his proposal that each organization is composed of five parts: the operating core, strategic apex, middle line, technostructure and support staff. To use the scenario of a manufacturing firm, the *operating core* is comprised of individuals who perform work which directly affects the production of the company's offerings such as assemblers and machine operators. The *strategic apex*, which includes the Board of Directors and Chief Executive Officer, ensure that the company is operating in an effective and efficient manner in order to maximize its return to its stakeholders. The *middle line* contains individuals who maintain supervision of the operating core under the guidance of individuals located within the strategic apex such as regional managers and factory foremen. The *technostructure* includes individuals who affect the work of others within the company by designing, planning, changing or training the operating core such as production and scheduling staff. The *support staff* is composed of individuals who provide value to the company but who do not directly interact with the operating work flow such as public relations and payroll staff.

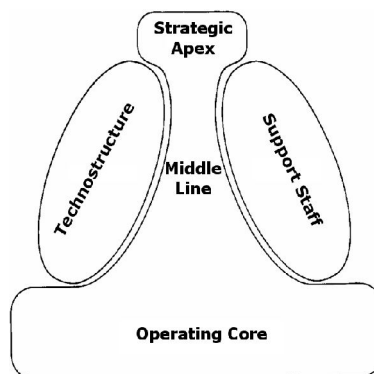


Figure 1. The five basic parts of the organisation [Min83].

THE FIVE STRUCTURES

The simple structure has its foundations based on direct supervision with the strategic apex holding considerable control over the direction of the organization. It has a small or non-existent number of employees who can be classified as belonging to the support staff or technostructure. Coordination is effected largely by direct supervision with authority over major decisions residing in the hands of the Chief Executive Officer. An organization based in Sydney which matches this description is herein referred to as "WebDesign" which provides customized web design services for small business clients. Their needs mostly concern having in-store promotions and trading hours advertised upon the internet along with the provision of electronic mail facilities. The company has been operating for two years and has been quite successful in attracting new clients through its flamboyant owner. There is little need for *WebDesign* to implement a formal management information system due to the fact that the company's direction and client relationships are managed solely by its owner. Due to the direct supervision co-ordination mechanism in place, there is also no need for formal communications since the owner simply obtains progress updates verbally from the operating core. The information gathering capability can be considered elementary with the Australian Taxation Office's Business Activity Statement requirements being a defining influence. It fits the suggestion that simple structures require only a crude and informal information system [Mil86]. The information systems within the company are centralized within the owner's desktop computer and all have functional usages. The computerized information system is utilized by all staff with primary design considerations and decisions being made by the strategic apex. When questioned about the decision making process for various software packages used by the company the owner replied his primary consideration was his previous knowledge of the software selected and its ability to synchronize data with his PalmPilot. One could say that the organization's information system is centered upon the owner with many areas only in his mind. Building on this concept, it can be said the information system within the simple structure is rather crude and simple being primarily designed to cater to the needs of the strategic apex.

The *machine bureaucracy* has its basis upon the standardization of work processes where the technostructure plays a leading part. This structure is used when the work is routine, the great part of it being simple and repetitive – hence allowing standardization of the tasks. This structure is typically found in larger and more mature organizations where the volume of the work and the size of the company allows it to settle on standardized methods to be used [Min83]. An Australian-based organization fitting this description is referred to herein as "ABC Telecoms" which provides telephony services, such as the facilitation of 1300 and 1800 numbers, to organizations within Australia. The company has been quite successful in its operation due to the usage of a proprietary transaction processing system called Infotel to lower costs and thus facilitating lower prices allowing the company to gain market share over competing services offered by Telstra and Optus. The standardized outputs required by the Australian Communications Authority which governs the 1300/1800 number services means that the transaction processing system is an ideal way to ensure compliance amongst the company's operating core. Each of the mostly part-time employees who work from home has a specialized task within the system and is ignorant of others. For example, one member of the operating core reconciles the company's bank account with the payments system of Infotel while another enters new payment details. The member who reconciles the payments has no knowledge or access to the sub-system which facilitates the entry of new payment details. The technostructure of the organization is quite powerful due to having control over the transaction processing system and its functions [Kee81]. There is little integration with the web-based customer relationship management application in use by the system to track, for example, the characteristics of large purchasers. It appears that the information system used is a classical management information system which emphasizes control but allows little integration [Jor03]. Moreover, the information system most important to this structure is a well-defined transaction processing system which can effectively ensure that the company's processes are followed by the operating core.

The *professional bureaucracy* is based on the standardization of skills where the operating core plays a primary role. This relies on the operating core to have the necessary skills and knowledge of their work in order to produce standard products. These standardized skills and knowledge are taught during training and indoctrination of the professional. Control over work is different as each professional works independently of colleagues but works closely with the company's clients. A company adhering to this description is referred to herein as "Dial-a-Technician". *Dial-a-Technician* provides information technology services catering to the needs of medium sized businesses

operating within Australia. These services are comprised primarily of technical support, network installation and preventative maintenance. All technical support professionals working for *Dial-a-Technician* are required to hold the Microsoft Certified Systems Engineer certification. Thus level of training required of its staff makes it unlikely that any effort to automate any significant portion of its work would be successful – by removing professional judgment it would make the main asset and competitive advantage of the organization, its professionals, redundant. Even if an attempt was made to computerize the operating core, the demands placed on the system by the company's clients would be too complex to handle. However, tools which make the professional's job easier and more efficient are always welcomed. For example, the company recently implemented an 'early-warning' system which allows it to check disk space usage and security settings to help minimize the number of disruptions occurring. It allows the professional to simply log in via a dialup connection to obtain progress updates and apply any necessary patches. Alternatively, a system which timed precisely how long it took for each professional to solve computing problems and tracked the professional's individual movements between client sites would be viewed with suspicion and not welcomed. It is noted that the same suspicions may be found in a machine bureaucracy but its workers do not have the complex skills of professionals [Jor03]. In support of this view, the information system which is fundamental to a professional bureaucracy's success is one which supports rather than controls the work undertaken by the operating core.

The *divisionalised form* is based on the standardization of outputs where the middle line plays a key part. Divisions within the organization are created according to markets served and are provided with the operating functions necessary to allow adequate servicing of these markets. There is a sharp division of labour between headquarters and the divisions with largely circumscribed and formal communications mainly focusing on the transmission of performance standards down and the performance indicators up [Min83]. A company fitting this description is herein referred to as "Charity Aid". The company is a non-profit organization providing products and customized advice to other non-profit organizations around the world. The organisation is split into three main operating divisions: The Empowering Communities Program which provides products such as volunteer management information systems, the Consulting Services division which provides financial management advice and the Public Relations division which handles marketing. Each division reports its monthly progress using defined performance metrics to *Charity Aid's* headquarters. Monthly performance targets are then communicated in writing using a formal procedure from the strategic apex to the middle line. Without a developed information system it would be very difficult to co-ordinate the activities of each division. In light of this view, it is suggested that an information system which supports the needs of headquarters to monitor and control the performance of each of the divisions is the most important information system within the divisionalised form.

The *adhocracy* is based on mutual adjustment where the support staff play a leading role. In order to be innovative it is necessary to not conform to established patterns, thus an adhocracy does not rely on any form of standardization or coordination. An organization within this structure gives power to the experts, professionals whose knowledge and skills have been highly developed within training programs [Min83]. A company matching this description is herein referred to as "*Innovate*". The company provides cutting edge financial management software which is developed internally by software engineers who hold doctorate-level educational backgrounds. The company's product is quite unique through its provision of advanced security measures and interfacing capabilities. Thus, while there is a large majority of professional skills in use to develop the product it would not be easy to retrain new staff due to the specialized and proprietary nature of the work products being developed. There is strong information flows between professionals within the team while communication with others was minimal and is restricted to the sole manager who oversees the project. The aim of the information system is to enhance team performance through increased communication in order to derive new ideas. It appears that an information system which mimics, supplements and supports the human networks involved in the operating core is an essential part of the operating adhocracy. The criterion for selecting an appropriate information system will concern to which extent its implementation would support and enhance the work of the team.

RESEARCH METHODOLOGY

In order to provide a valuable examination of Mintzberg's proposed organizational structures in practice it was necessary to examine five Australian companies which adhered to each of his structures. A research schedule was established for interviewing prospective companies using semi-

structured questionnaires, which are included within the Appendix, in order to initially determine their suitability to participate (Form A) and then to obtain the necessary data for the study (Form B).

The primary data collection method was determined to be structured interviews conducted via telephone. The questionnaires were a compilation of many items from a variety of sources which included Jordan [Jor03], Mintzberg [Min83] and Lucas [Luc86]. The questionnaire was designed to be administered directly by a single interviewer. The interview subjects were members of the company's strategic apex due to the fact that the aim of this study was to ascertain the decisions made by the apex to support their business strategy.

The companies examined within this study closely align to Mintzberg's proposed organisational structures. As can be said of any real-world study it could not be reasonably asserted that any company will match Mintzberg's structures with flawless precision. When selecting the five companies to be examined out of the total sample of twenty-three organisations data was collected using a structured interview. The interview was conducted using the standardised questionnaire included within the Appendix and labelled as Form A. The final decision of which companies to study was indeed a difficult one which involved some element of subjectivity. The primary goal was to ensure that the companies selected from the sample were the ones who most closely matched Mintzberg's theories. Thus, the small sample size and element of subjectivity could place limitations on the applicability and validity of this study to other ICT companies. The companies which were selected to participate were examined using a separate and more detailed structured interview designed to collect data regarding a number of issues. The structured interview questions used are included within the Appendix as Form B.

Where available, internal and external documentation originating from the companies involved was examined. Internal documentation included formal reports dealing with Information Systems and inter-office memorandums. External documentation was mostly restricted to what was placed on the company's website such as media clippings and annual reports.

Interviews with the strategic apex formed the foundation of the data collection performed, where questions covered the structure of the organization, its competitive strategy and the role of information systems within the organization. The data collected from these interviews was then corroborated with the internal and external documentation sources to form supporting sources.

FINDINGS

Throughout the data collection phase it became apparent that many companies did not adhere exactly to Mintzberg's theories. However, in order to effectively investigate information systems with relation to Mintzberg's theories of organizational structure it was necessary to examine five organizations within the sample set of fourteen organizations which most closely matched his proposals. It also became evident while exploring the dimensions of the information systems in usage that the model predates many of the newer forms of organization brought about by the advances in technology. This was found to be most evident in the relative lack of journals and books published discussing Mintzberg's theories after the 'boom' adoption period of his ideas in the late eighties. Within the context of this relatively small-scale study with hand-picked subjects which adhered most closely to Mintzberg's theory, thus there is a significantly increased likelihood that would be found as correct and applicable to information systems. However, there were some organizational types where organizations adhering very closely to the type were unable to be located. In light of this, the varying information systems prompted by differing organizational structures can be discussed.

Within the simple structure which was represented by *WebDesign* it was found that Mintzberg's theory is highly applicable. The strategic apex of the organization holds considerable control over the information system used within the company – bordering on serving the needs of the strategic apex at the expense of others. Financial records are maintained via the usage of a popular off-the-shelf accounting software package which was selected, and can only be accessed, by the strategic apex. This particular software package also includes the provision of Customer Relationship Management functions. Access to the Customer Relationship Management system is again specifically restricted to the strategic apex. Specialised tools are used for the development of websites are selected and specifically configured by the strategic apex.

Within the machine bureaucracy Mintzberg's theory was again quite applicable with the technostructure of *ABC Telecom* ensuring a standardized work process is followed through the usage of a transaction processing system. It was interesting to note that this system was used primarily as a means of control by the technostructure rather than facilitating integration which could be of use to the middle line and strategic apex. The company's client details are maintained through an internal database which is accessible to the operating core to some extent and completely accessible to the strategic apex. *ABC Telecom's* business systems are mainly composed of a heavily standardised proprietary system which handles the provision of the service which offers no integration with other areas of the business.

The professional bureaucracy deviated from Mintzberg's theory in that due to the evolving nature of technology each professional with the company had a slightly different solution to any given problem – thus it could not be said that the output was perfectly standardized. The staff also appeared willing to allow small amounts of monitoring such as recording which professional was assigned to which project but resisted more invasive forms of tracking which was discussed earlier. Within *Dial-a-Technician*, client details are maintained via proprietary software by call centre staff and are available to support engineers and management personnel. Financial records integrated within the proprietary software used for customer relationship management – clients who fail to settle invoices for services provided are noted. Employee performance is measured by client satisfaction and technical indicators. New technology spending is evaluated by the strategic apex on the basis of return on investment. This is in stark contrast to the simple structure's and machine bureaucracy's control – the professionals of the organisation are given much more decision making power.

The divisionalised form examined within *Charity Aid* roughly adheres to Mintzberg's theory – the main absence being the lack of a unified information system implemented across all the divisions to allow monitoring by the company's headquarters. It was noted however that each division reports its monthly progress to headquarters located in Sydney. Monthly performance requirements are communicated in writing from the strategic apex to the middle line. The issue of a inconsistent set of information systems being in use throughout *Charity Aid* was highlighted as a concern. In recognition of this, an information system which supports the needs of headquarters to more closely monitor and control the performance of the divisions can be considered a critical part of a divisionalised form's competitive strategy.

The adhocracy seemingly followed standards set within the operating core such as the use of coding templates. Thus, Mintzberg's proposals did not accurately resemble the company's information system. However, it can be said that for the adhocracy an information system which mimics, supplements and supports the operating core is the most appropriate information system to be implemented. The complex nature of the work undertaken however meant that approval of spending decisions, made during planning meetings, were lead by the operating core – the research and development staff. Therefore it could be said that Mintzberg's theories did hold some resemblance to the company's information systems.

CONCLUSION

Through the study of the five company's distinctive features became apparent, which were also cited by the strategic apex, as contributing significantly to the company's financial success.

For the simple structure, it is important to have a management information system which is highly accessible to the strategic apex. The usage of a highly accessible management information system translates into higher client satisfaction via the appearance of an attuned executive in front of clients.

Within machine bureaucracies, it is important to have a highly reliable information technology infrastructure to facilitate reliable customer service. Stories abound of automated systems where clients become frustrated resulting in heavy business losses [Eco04]. The infrastructure which facilitates customer service is likely to produce a significant competitive advantage for the organisation.

Professional bureaucracies rely on technology in a support role – the organisation's information technology infrastructure aids in boosting productivity. While the infrastructure may not provide a significant competitive advantage, not having a sufficient infrastructure in place will make the company uncompetitive.

Divisionalised forms depend on information systems for co-ordination within the organisation's headquarters and its divisions. Without an adequate information system in place the company cannot function effectively as a single entity. It's information technology or information systems infrastructure does not normally constitute a competitive advantage.

Adhocracies require advanced information technology infrastructure and a specialised information system to remain competitive. Information technology infrastructure is required to aid the operating core in carrying out its research and development efforts. A specialised information system is required due to the unstructured nature of research and development tasks. Without these two elements the company will not be able to continually innovate and hence fall behind its competitors eventually resulting in an outdated product and services set.

By accurately aligning an organization's supporting information systems to its structure significant competitive advantages may be gained. Through an organizations review of the most appropriate information system it becomes easy to determine whether the information system employed by the organization effectively supports the structure both now and in the future.

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APPENDIX

Structured Interview Form A

Question 1: How is the company organised?

- Describe the management structure of the organisation
- How are employees supervised?

Question 2: How does the company complete client work?

- What level of education does the average operating core employee possess?
- How do senior management and operating core employees interact?

Question 3: What is the environment of the company?

- How old is the company?
- How many employees does the company have?

Structured Interview Form B

Section 1: What sort of information technology infrastructure used by employees?

- Desktop computers? If yes, specify CPU brand and model (e.g. Intel Pentium 4 3.2 Ghz or AMD Athlon XP 1800+ or Intel Celeron 1.8 Ghz)
- Laptop computers? If yes, specify CPU brand and model (e.g. Intel Centrino 1.2 Ghz)
- Hand held computers? If yes, simply state either the brand name and model number (e.g. HP IPAQ 1200)
- What operating system and version of Microsoft Office is used?
- Mobile phones? If yes, is the extending technology offered used for business purposes (e.g. SMS updates of new email arriving)?
- What other types of telecommunications equipment is available? E.g. individual fax numbers, email addresses, telephone number extensions?
- What level of printing facilities do employees have access to? (e.g. monochrome/colour laser printer, special high-resolution printer)
- How fast is the company's internal network connections and what is the speed of the company's internet connection?
- What backup facilities are in place? E.g. data storage, power generators
- What level of security is used for confidential business information? Is it simply passed on a needs to know basis or is it a password protected document..?
- Is there a 'standard' image installed on each of the computers?

Section 2: How to employees of the business interact with the information technology infrastructure?

- How does the company generally relate to its clients? (e.g. face to face meetings, requiring the customer to fill in a set form, telephone meetings)

- If divisions exist within the company, are they all using the same set of software or is it more customised to the needs of the specific employee?
- Accounting – how are the accounting records of the business maintained? Who maintains these records? Who has access to these records?
- Customer Relationship Management – how are client details maintained? Who maintains these records? Who has access to these records?
- Technology services – who maintains the computers within the company? Who has administrative access to the system?
- Is there any integration between any of these components or are they accessed separately using the respective software products?
- How is employee performance measured within the company?

Section 3: What tools, techniques and methodologies are used by the operating core?

- Is there a tool used for completing work for clients? Is it a specialised tool which only certain employees use? Would it be easy for a layman to learn how to use?
- Is there a set technique used for completing work for clients? Do all employees use the same Word template or programming standard for example?
- Is there a set methodology used for completing work for clients? Could this be called a set procedure or are employees free to use their professional judgement? How is this technique implemented – in writing, through software, through word of mouth?

Section 4: What is the contribution of IT/IS to your business?

- Do you believe your Information System(s) or Information Technology equipment and technology-related intellectual property provides you with a competitive advantage in the marketplace? Why? Would you extend that concept to your IS/IT being vital to your organisation?
- Do you have a defined Information System(s) or Information Technology strategy? How detailed is this strategy? Is it short term or long term? What sorts of components does it take into account?
- How is information technology spending evaluated for approval within your company?