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E-fulfilment Systems for Quality Healthcare Delivery: A New Construct for Visualising and Designing

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Abstract

Electronically delivered information and funds transaction systems do offer such organisations great potential for efficiency and effectiveness, but many large integrated ICT systems, particularly in public service projects, have notoriously underperformed and disappointed. To ensure that quality is 'engineered in' a holistic, integrated and quality approach is required, and Total Quality Management (TQM) principles are the obvious foundations for this. TQM is a business philosophy that encourages an over-arching responsibility - both individual and collective - to quality and customer satisfaction. This paper describes a novel approach to viewing the operations of a healthcare provider where electronic means could be used to distribute information and facilitate electronic fund settlements, building around the Full Service Provider core. Specifically, an approach called the "triple pair flow" model is used to provide a view of healthcare delivery that is integrated, yet detailed, and that combines the strategic enterprise view with a business process view.

Key words

Healthcare delivery, quality, enterprise and business process views, triple pair flow construct.

INTRODUCTION

Like many ventures, especially those in the public service sector, organisations responsible for healthcare delivery are presently facing competing challenges. Health managers are seeking to satisfy the ever increasing number and size of stakeholder groups with quality healthcare delivery that meets the patient's needs, whilst delivering quality healthcare data to the hospial (Aggarwal and Zairi, 1997). Healthcare delivery quality, as defined in (Rivers and Bae, 1999) "as that kind of care which is expected to maximise an inclusive measure of patient welfare, after one has taken into account the balance of expected gains and losses (variability) that attend the process of healthcare in all its parts." Clearly, the complexity of this task cannot be under estimated. It requires the development of effective management and operational processes that are capable of capturing information to support the management and control of healthcare delivery. The captured information allows healthcare providers to evaluate the effectiveness of actual patient care, the efficiency of the hospital operations, the appropriate usage of resources and the expectations of patients, physicians, other hospital staff, etc, to develop measures of quality management in healthcare provision. Information and Communication Technology (ICT) support and help management of complex processes and operations with Enterprise Systems (ES) and Enterprise Resource Planning System (ERP) providing organisational wide systems that capture the processes of the organisation (horizontal flows) (Madu and Madu, 2003). Moreover, eBusiness (and eCommerce) systems support the provision of services and/or goods electronically, e-fulfilment and these systems provide management with not only an effective tool to deliver product, information and funds but provide management with a method to model the strategic possibilities and implications to support healthcare delivery.

As healthcare management move into the development of new healthcare initiatives and private-public partnerships become more common this will introduce an environment of simultaneous social, political and business objectives. The need for strategic vision in the executive group to be communicable to and useable by the other stakeholders in their developments is essential. This allows all stakeholders to gain a mental picture or model of what is being achieved and focuses management on: envisioning, specification, design and implementation. This can be surfaced and articulated with other stakeholders in such a way that they can see within their area, business processes and technological infrastructures that are the basis of their thinking. This

will ensure that quality is 'engineered in'. A holistic, integrated and quality approach is required, and Total Quality Management (TQM) principles are the obvious foundations for this. TQM is a business philosophy that encourages an over-arching responsibility - both individual and collective - to achieve quality and customer satisfaction. Commitment must be at every stage of the delivery. Importantly, the successful implementation of TQM will require the alignment of the organisation's information systems and other management systems with the new TQM environment.

This paper describes a novel approach to viewing the operations of a healthcare provider. Electronic means could be used to distribute information and facilitate electronic transfer and management of financial resources (funds), built around the eBusiness model - Full Service Provider core (Weill and Vitale, 2001). Specifically, an approach called the "triple pair flow" model is used to provide a view of healthcare delivery that is integrated, yet detailed, and that combines the strategic enterprise view with a business process view. In this case we will be highlighting the issues faced by the hospital as a provider of healthcare to a community. In section 2 we examine the suitability and aptness of a business process engineering approach in the design of healthcare fulfilment systems within TQM principles; we also reinforce the need for an integrative, holistic approach which can involve all stakeholders. Section 3 describes a new modelling tool, the "triple pair flow" construct, to support an integrative design process. The approach uses business processes diagramming techniques from system dynamics, which capture detailed stock and flow structures in the various inter-relating processes, combined with the characterisation of different e-Business proposition models by Weill and Vitale. Examples of specific hospital processes – the gathering and transmission of government required data against funding formulae, and the system for undertaking diagnostic tests with payments and reimbursement processes – are presented in section 4. We argue and conclude, that this approach offers significant benefits in providing an easy to visualise process view, integrated with a higher level strategic business model. This is in order to *design-in* the effective system and address stakeholder needs and concerns that are a hallmark of quality system design.

PROCESS AND INFORMATION TECHNOLOGY INTEGRATION TO SUPPORT QUALITY HEALTHCARE DELIVERY SYSTEM DESIGN

The use of information technology and systems within the healthcare setting has become the basic tool of operation and management. Managers are capable of providing great potentials for efficiency and effectiveness by utilising these electronic processes for disseminating and receiving relevant information in support of the healthcare delivery process, that is providing the right information, to right person, at right time.

However, many large integrated information systems, particularly in public service projects, have notoriously underperformed and disappointed (Lowson and Burgess, 2003). Often the majority of healthcare organisations do not understand the impact and effect of operating an integrated information system that captures the core processes of the organisation. Moreover, systems of this nature dramatically and fundamentally change the way the organisation operates and interacts with its primary organisational objective and outcome: patient care. Similarly, healthcare managers may often have different objectives in their roles to support the organisational objective (Adinolfi, 2003). In this sense: clinical practitioners will primarily focus on the processes concerning patient outcomes; senior management on trend analysis and successful long term strategies and strategic planning; middle level management and reviewers with monitoring, review, productivity and resources utilisation; and business services management with billing, budgeting and accounting. Similarly, each group will have specific key performance indicators of their area's performance in meeting the organisational objectives and outcomes.

Healthcare managers are responsible for the envisioning, specification, design and implementation of new electronic processes and must therefore take a holistic, integrated and quality approach. TQM principles are the obvious foundations for this. Total Quality Management (TQM) is essentially a business philosophy. For TQM to be successful, management decisions must be aligned and integrated into a system of continuous quality improvement to meet the expectation of the customer. Moreover, it is a systemic approach that considers the interactions between the various elements of the organisation. The overall effectiveness of the system is higher than the sum of the individual outputs from the subsystems. Hence, we can imply that any product, process, or service can be improved, and a successful organisation is one that continuously seeks and exploits opportunities of improvement at all levels (Adinolfi, 2003). Commitment must be at every stage of the healthcare process from initial diagnosis and treatment, through to post acute care services. Moreover, commitment from top level management is paramount to the successful alignment of organisational processes and the TQM environment of the organisation.

There is a large amount of literature on the topic, and there are at least two major models that are used for business excellence assessment based on TQM principles – the EFQM Excellence Model (EFQM, 2003) and the Baldridge Award (NIST, 2001). These two world benchmarks use very similar criteria and dimensions for

assessment, and both include Leadership, Processes, Information, and People Involvement as critical elements. However, much of this is essentially diagnostic or aspirational – 'do we think we are a quality organisation?' or 'what should a quality organisation look like?'. The appropriateness of a direct TQM approach in healthcare is long established (for example, (Adinolfi, 2003, Aggarwal and Zairi, 1997, Rivers and Bae, 1999)) though little is instrumental in the sense that it provides tools that can directly support the development of effective, coherent, and purposeful systems within an organisational quality framework. This is particularly the case when it comes to the design of integrated fulfilment, information and fund transaction systems in complex information systems in a healthcare setting.

Repenning and Sterman (2000) correctly reported that there is a growing emphasis on business processes rather than business functions as the keystone to organisational improvement and quality enhancement. Process oriented improvement techniques such as Total Quality Management and Business Process Reengineering have proven to be powerful tools for improving the effectiveness of many organizations. However, despite the fact that it is easier than ever to learn about these performance improvement techniques and where they are being used (presumably beneficially), there appears to have been relatively little improvement in the ability of organisations to incorporate these innovations in their everyday activities. Similarly, the authors observe that the ability to identify and learn about new improvement methods no longer presents a barrier to most managers, but rather the biggest challenge is successful implementation. Repenning and Sterman (2001) also assert: "You can't buy a turnkey six-sigma quality program. It must be developed from within."

A MODELLING APPROACH TO INTEGRATE THE ENTERRISE VIEW WITH A BUSINESS PROCESS VIEW

Previous work by the authors has integrated thinking from strategic management, business process engineering, and resource-based view (RBV) of the firm and balanced scorecard (BSC) analysis to produce an integrating framework for e-business design. This framework reflects both a top-down, entrepreneurial/customer-facing view with a bottom-up, instrumental, capability-based view of what can be done (Joyce and Winch, 2003, Joyce and Winch, 2004, Joyce and Winch, 2005a, Joyce and Winch, 2005b). The original framework, which itself essentially reflects aspirations, has then been integrated with the e-business models of Weill and Vitale (Weill and Vitale, 2001) and the process flow modelling from system dynamics used to present a method for visualizing, communicating and then developing a shared view or consensus on the critical flow processes that can operationalise a business vision (Joyce and Winch, 2004). The visualisations support the critical examination of base ideas by different stakeholder groups and different domain experts; the prototype systems can then be expanded and refined of to best serve the precise needs of the organisation and its stakeholders. This, it is argued, supports powerfully the process of internal development of systems that are part of and support a quality environment within the organisation.

THE 'TRIPLE- PAIR FLOW' CONSTRUCT FOR ENVISIONING FULFILMENT SYSTEMS

All business transactions are in one way or another a supply chain fulfilment system, and healthcare delivery systems are no exception. A goods or services need is fulfilled (i.e. satisfied) by the good or service being delivered or provided with payment being received by the supplying organisation in exchange. Effectively, three flow processes comprising all such systems:

- information flows;
- money flows, payment for goods or service; and
- delivery of goods or services.

These are just the primary flows, in a healthcare system delivery of patient-care comprises a variety of service elements including medications and other consumables, and similarly money flows may be direct from patients, from insurance companies and government funding agencies. These may be seen as refinements, alternatives or extensions of the primary flows above. However, an important consideration is that each of these flows can be two-way:

- Reverse information flows might include order acknowledgements, delivery notices, invoices, out-of-stock notifications, etc. It might also include information not directly related to individual order fulfilments, for example, stock position advisories and so on;
- Reverse money flows might be refunds, cash-back, commissions, etc; and
- Reverse goods flows might be returns, trade-ins, etc.

Joyce and Winch (2004) have described a novel construct – the "triple-pair flow" construct for envisioning such systems based on six main flows: two-way information, two-way goods and services, two-way money flows, as shown in Figure 1. If all the relevant flows relating to a particular healthcare provider could be represented within this triple pair model, then the configuration of the six flows can be mapped onto any business model that

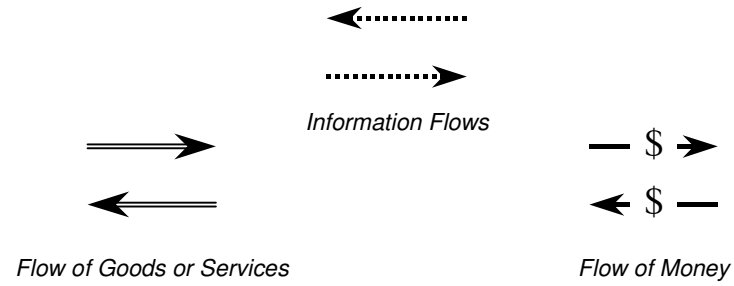

Figure 1: The 'triple-pair' process flow model of supply chain fulfilment

the healthcare company has in place, or wishes to adopt. Using the stock-flow diagramming convention of System Dynamics extends their construct. We will investigate how business process models can be mapped onto business models. System Dynamics is well suited to this application. There are many excellent texts that describe the principles and processes in system dynamics modelling and (Sterman, 2000) is a leading example text. From system dynamics earliest day of development (Forrester, 1961), has always explicitly reflected industrial and business structures as a complex inter-related set of flows of money, materials and information, and has always been concerned with the structural relationships that make up business processes as well as the softer processes. This dynamic process model perspective leads to a representation of the enterprise as a set of

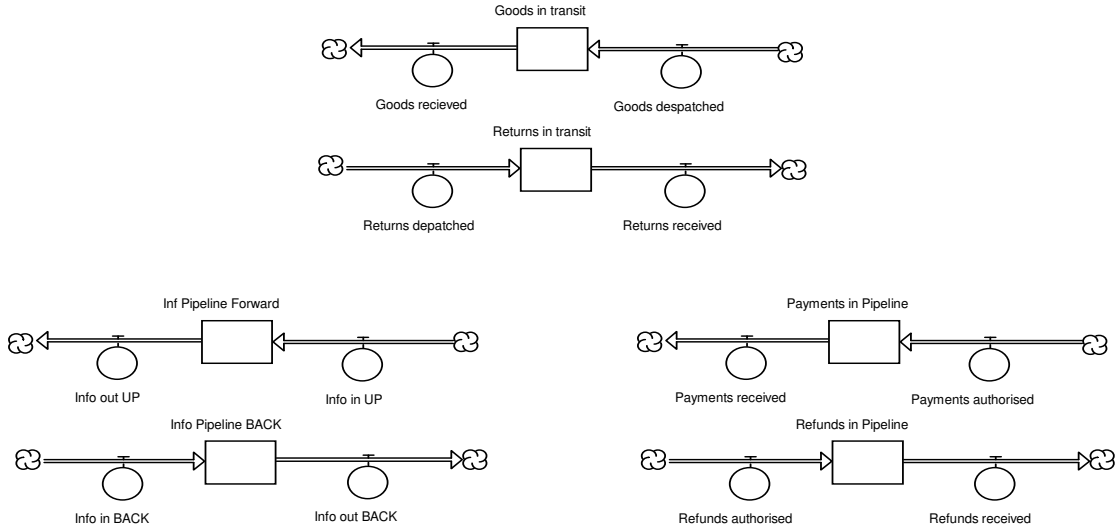

Figure 2: The triple pair model with detail for each flow process

six sub-systems comprising stocks (or levels or inventories) and flows, as in Figure 2. This basic enhancement simply establishes that extension with detail is possible, and that the sub-structures will comprise a set of stock-flow chains. The process of expanding this to a full representation of the supply chain(s), funds transaction chain(s) and information flows can then proceed as an iterative process involving all key stakeholders. The graphical processes involved in system dynamics are proven to be of significant effectiveness in supporting team building, alignment, communicating views and thoughts with different specialist groups, and consensus building (see for example, (Chandra et al., 2002, Richmond, 1993, Vennix, 1996, Winch, 1993, Winch, 1995)). It is also the basis for what (Richmond, 1993) described as "operational thinking" within what he considered the amalgam of critical thinking skills.

CHARACTERISING ELECTRONICALLY-BASED ENTERPRISE STRUCTURES AND PROPOSITIONS

In seeking to understand the nature and processes of electronically-based activities in enterprises, Weill and Vitale articulated eight basic categorizations which they style as 'atomic' models - 'atomic' in the sense they can represent single structures, or be used in combination to produce molecular models of more complex organisations (Weill and Vitale, 2001). The simplest of their models is the Direct-to-Customer (D-t-C) model representing the simple supply of goods or services to customers directly by the company (Dell Computers is a good example). Their representation of the actors and their inter-relationships is shown in Figure 3.

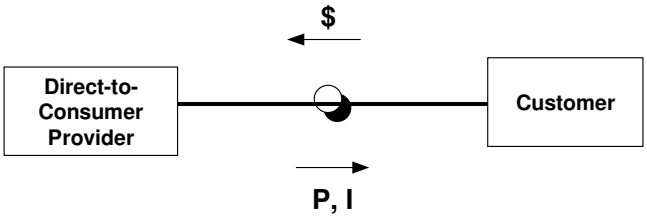

Figure 3 – Weill and Vitale's schema for their Direct-to-Customer model

Joyce and Winch (2004) have demonstrated how the broad characterisations of the Weill and Vitale models can be 'fleshed out' with a detailed description of the actual flow structures that enable the operations of such a firm to be envisioned, communicated and refined. The development processes is able to integrate the ideas and perspectives from those with a strategic (even entrepreneurial) viewof the organisation, business process managers, and technical infrastructure experts to ensure all stakeholders share a common view. These are acknowledged in all TQM models as a key element in an effective total quality application. An enhanced version of the D-t-C might look like Figure 4, though this would still reflect an enterprise with relatively simple processes.

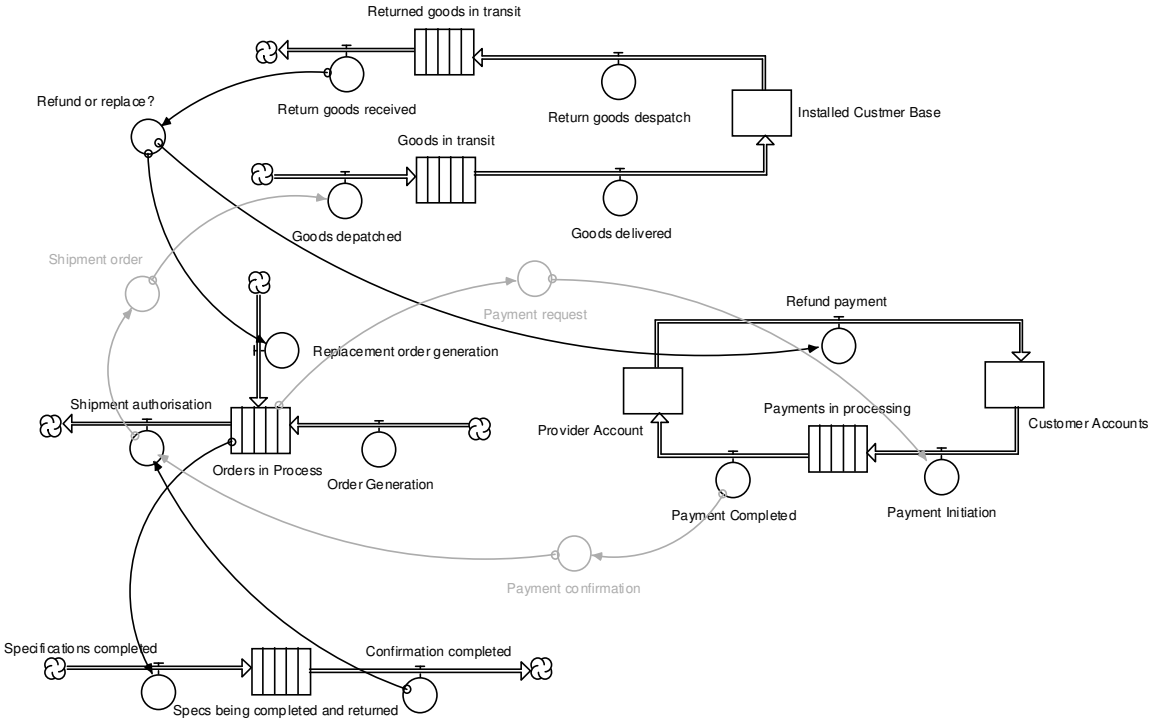

Figure 4 The extended D-t-C model with detail of goods, funds and information flow processes.

This version makes specific assumptions about, for example, the fund transfer mechanisms and at what point deliveries are triggered and invoices are raised. Stakeholders could review this model to determine if they and others would be best served by this structure and where and how it could be improved.

AN INTEGRATIVE DESIGN PROCESS FOR QUALITY HEALTHCARE DELIVERY AND STAKEHOLDER NEED FULFILMENT

One of the other Weill and Vitale (Weill and Vitale, 2001) models is the Full Service Provider (FSP), which they define as "offering a full range of services in one domain … directly as well as via 'complementors' ". Critically, they include health care provision in this group. They discuss how this sector can be served by enterprises with stakeholder groups and interconnecting goods/services, information and money flows as well as characterise the FSP model by a simple schema linking these and characterise the actor and flow structure as in Figure 5. This business model reflects the situation where access to a range products or services is provided through a primary provider who might not only supply its own products or services, but also sources related products and services from partner organisations. The primary relationship in this system is between the

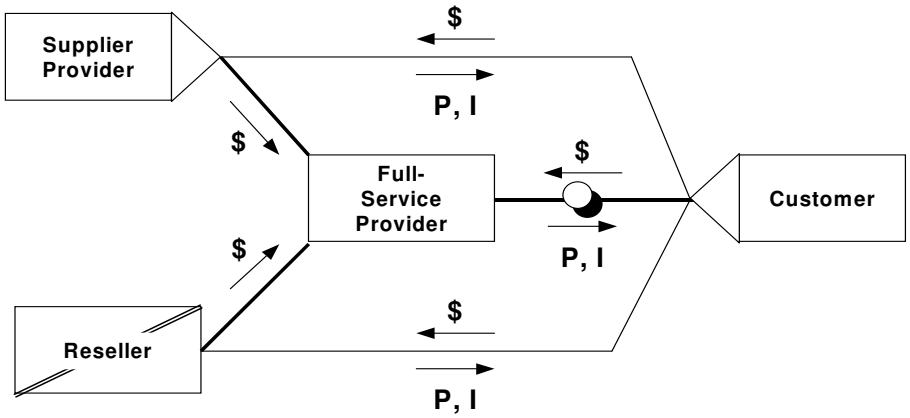

Figure 5: Weill and Vitale's Characterisation of their Full Service Provider Model

provider and the patient, but there are additional relationships involving flows of money, product/services, and/or information between the provider and its second-level supply network partners – which Weill and Vitale consider could be suppliers or complementors (resellers and other suppliers of complementary products and services) – and between the second-level suppliers and customers.

From an overview of the fulfilment processes in a health service - patient care delivery, fund transaction and information flows, including suppliers of medications and other consumables, private and public funding bodies, and regulatory bodies, it is easy to see how these map onto the FSP model in its simple form. This then is the starting point for using the triple-pair construct in the envisioning, specification and design of systems that will engineer in the customer focus, stakeholder alignment and system coherence necessary to achieve quality healthcare delivery.

DIMENSIONS OF HEALTHCARE DELIVERY WITHIN A FULL SERVICE PROVIDER PERSPECTIVE

Through TQM management system managers are able to integrate the vision of quality into the structure of the organisation. This must been seen at the clinical level, in the direct support of suitable patient outcomes, and from a management level, in the direct support of financial and business services and to ultimately create an accountable strategic plan for long term quality achievements. If we consider the role of a hospital as a domain in its attempt to provide quality healthcare we are able to examine the implications of the Full Service Provider Model providing a clear picture of the process of healthcare provision and the implications of TQM. The development of information system architecture with an emphasis on TQM is possible by the development of new systems or the redevelopment of older bureaucratic systems. There is a tendency when reviewing information systems in the healthcare area to create separate decision systems and management systems. Information systems within healthcare domain often fall into three categories (Rivers and Bae, 1999). These are:

1. Clinical or medical information systems – designed to support the activities of patient support (i.e., hospital admissions, medical records, etc)
2. Operational administrative systems – designed to provide necessary non patient care activities for the organisation (i.e., financial, personnel, payroll, etc)
3. Decision support systems – designed to provide management with information for decision making (i.e., strategic planning, analysis and evaluation, etc)

This has caused information systems within the hospital setting to be disjointed or loosely coupled and in the worst case not integrated at any level. In order to address this common problem is the development of integration of data and information into an enterprise wide information system (Green and Joyce, 2005). In considering the structure of an effective information system focusing on TQM the structure must provide support to the essential area within healthcare, especially in a hospital healthcare setting.

EXAMPLES OF KEY HEALTHCARE SUB-SYSTEMS

If a complete healthcare organisation can be seen as a (FSP), within the Weill and Vitale classifications, then potentially new or reorganised structures can essentially be viewed via extensions of their Direct-to-Customer model. At the core will be a central service delivery sub-system, which, using the 'triple pair' flow interpretation this would be a modified version of Figure 4, reflecting the technical details of the individual healthcare organisation, with the provider and the patient as the key players. In addition there would be other subsystems presenting the other inter-relationships between the FSP provider – the healthcare organisation itself – the patients and the other stakeholders. The two subsystems described briefly below can be used to demonstrate how the triple pair flow representation give a detailed integrative process perspective of the hospitals operations.

Patient Management System and Government Reporting

The patient management system maintains the primary source of patient demographic information for the organization. It is a detailed, date related database that is an integral corner stone for health care providers as they move towards an electronic health record. Enhanced systems also maintain data encompassing patient admissions, ward transfers, discharges, appointments, operations and other clinical interactions. In one specific public health funding model the total procedures and diagnosis attributed to a patient during their inpatient stay are assigned a single code. The government health body responsible for funding and health quality uses this code in conjunction with the length of the patient's stay (LOS), time in intensive care and other critical clinical issues. The LOS is compared to the statistical mean of other patients accorded the same code from other health services and the level of funding determined. Funding is assigned to the health service retrospectively to the patients discharged from hospital. In some clinical areas such as the emergency department and surgical waiting list bonus funding can be achieved by meeting preordained patient related performance targets.

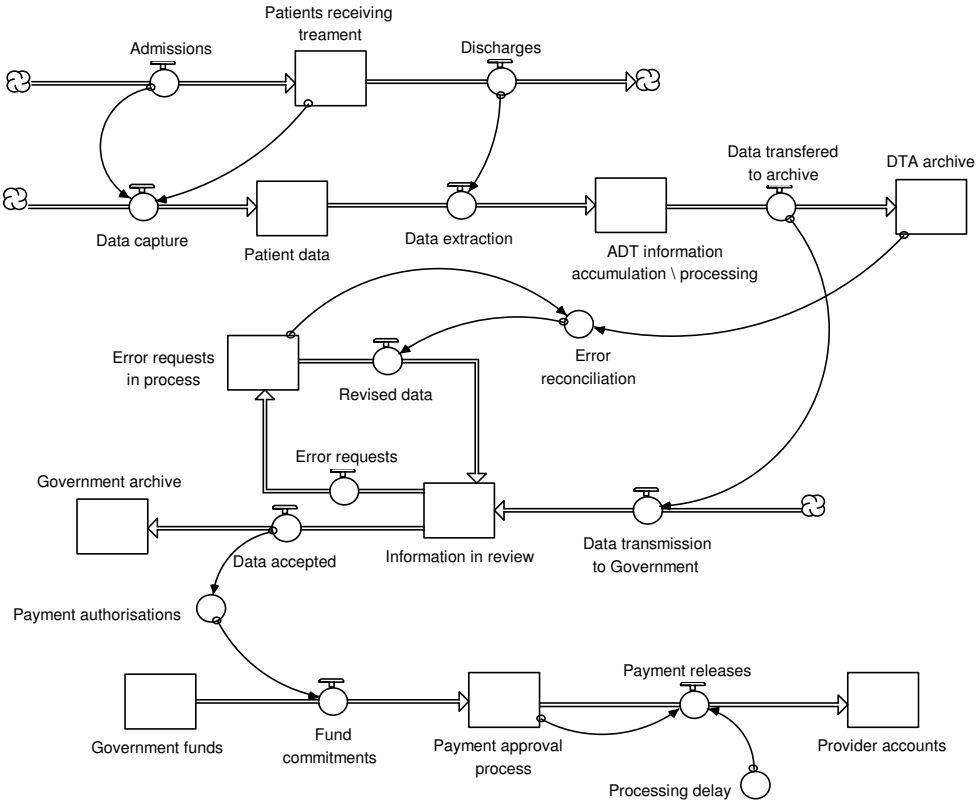

Figure 6 – Integrated process view of the ADT sub-system

A Triple Pair Flow View of the Processes in the Patient Management System and Government Reporting

Using the construct described above, a first representation of the flow processes involved might appear as Figure 6. The sub-system is driven by the patient treatment process – this is shown at its most basic level of detail at the top as a simple admission / in-treatment / discharge process. (In a full model, this would involve a much greater level of detail as part of the core patient care delivery system.). Patient data is captured on admission, during treatment and on discharge, in the Admission Discharge Transfer (ADT) module of the clinical information system. After the data is accumulated, analysed, corrected and coded it is archived but also transmitted to the appropriate government body. This data may be checked against previous files and errors or anomalies returned to the hospital for review, after which it will be returned to the government body – this process is shown in an information recycling route. When the information is finally accepted it will be absorbed into the government body's database and, where appropriate, will trigger related payments to the hospital.

This is a first simple diagram and is based on certain assumptions about how health care activities are undertaken and what triggers particular activities. For example, in this representation, data is accumulated and analysed in the ADT system at the hospital and transmitted subsequently, possibly on a weekly or monthly basis, to the government; it is conceivable that at the present time or in the future this data could be transmitted in real time, in which case the model representation would be amended slightly. The model reflects an integrating view of how this subsystem presently operates or could operate in the future. It links the three critical process flows – patients, information, and funding, and can form the basis for debate and discussion on the effectiveness of the system and how the various stakeholders' needs and responsibilities inter-relate. While embedded within established business process engineering principles, the diagram is easily envisioned in terms of operations on the ground, enabling the focus of attention to be on the design of systems that will effectively deliver to all stakeholders. It can incorporate all-important data flow and identify trigger points which will impact on other stakeholders – for example when payments are to be triggered.

Diagnostic Testing and Payments Sub-system

Diagnostic test order entry has ethical and security implications but in the appropriate system is a quality initiative for data entry into a diagnostic management system. It also has the advantages of reducing data entry clerk errors, save clinical time eliminating paper based sitting in a box waiting for collection and provides the clinicians ordering diagnostic tests immediate feedback on the cost of the tests being ordered and previous diagnostic interventions. Diagnostic test requests are delivered electronically to other systems both internal and external to the organization where diagnostic tests have been outsourced. Once the tests have been completed for the patient, information is returned to the diagnostic management system in the form of results. These results if in particular are of a pathology nature can be in a cumulative format to provide instant access to trend analysis. Cost of the tests performed and billing requisition is also returned in a combination of electronic and hard copy means to the health care provider, government body, insurer or patient him or herself.

An integrated view of the processes involved in diagnostic testing

The second sub-system discussed above concerns diagnostic testing, and again a simple representation of the integrated set of process flows is shown in Figure 7.

The central spine of the diagram reflects the process of requests for diagnostic tests being raised and then completed. Depending on hospital procedures, tests orders might be raised at the point of treatment or through a central function. When test orders are issued they trigger the request for the test at the test service providers – an internal department or external vendor – and are then logged into the diagnostic test management system. In terms of understanding the inter-related processes from the hospital's perspective, the depiction here is possibly adequate, though the vendor itself will have its own interacting system of test backlogging, information management and so on.

When the test results are received back by the management system, payments to the vendor can also be triggered. The management system will also analyse all tests completed and bill out as appropriate to the responsible institution, the patient him or herself or their insurer. As part of the system, represented as a small structure at the bottom left, a database can be maintained to provide feedback to clinicians and possibly to inform them for their future clinical decisions. Data may be accumulated, analysed for trends and so on as well as provide external agencies involved in disease containment and healthcare policy. As in the previous example, this is only a very simple representation capturing processes only at the coarsest of levels in terms of aggregation, detail, and alternate or parallel processes. Such an initial model as this will likely be the starting point for an integrated design processes for emerging systems.

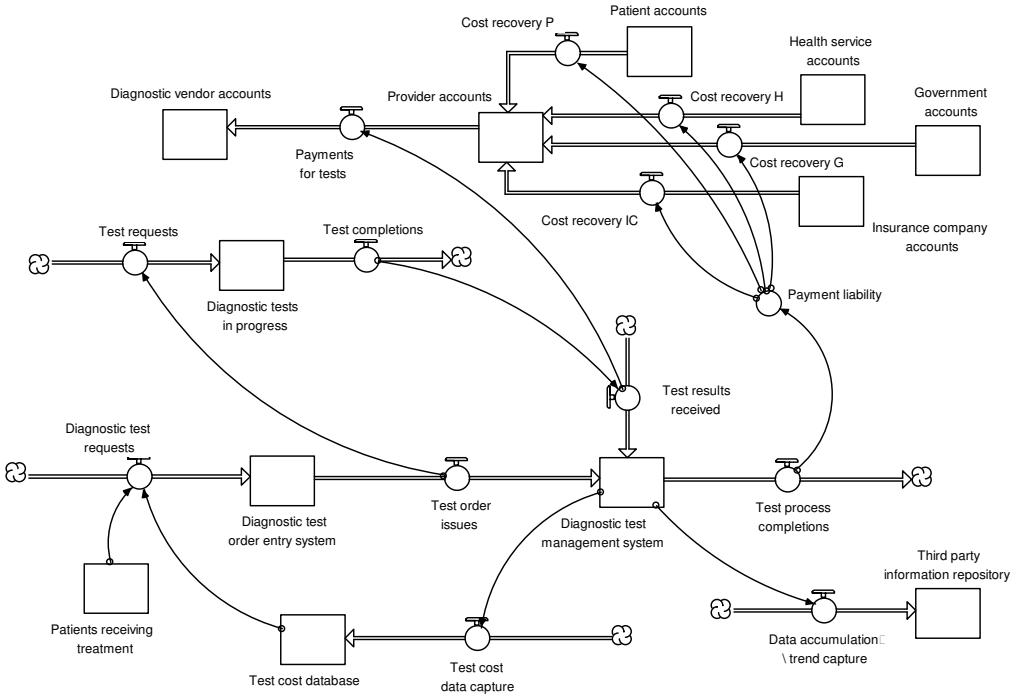

Figure 7 - Service, information and money flows involved in diagnostic testing

CONCLUSIONS

This paper describes a detailed view of the operations of a healthcare provider where electronic means could be used to distribute information and facilitate electronic fund settlements, building around the Full Service Provider core. Particular attention is paid to the systems surrounding specific procedures where governments establish targets and payment to healthcare providers is contingent upon them meeting these needs. This exemplifies the complexities where the 'customer' can be defined as both the patients as beneficiaries and government bodies, healthcare trusts, and/or health insurance companies as primary funders, and where complementors like pharmaceutical and test service vendors also have an interest in systems that are both fast and accurate. Focussing on the expectation within the TQM principles that leadership/vision, strategic planning, effective process design and stakeholder involvement must be fully integrated. Possible example fulfilment structures are developed to show how the triple-pair-flow construct produces visualisations of possible systems to ensure that design links directly and transparently to customer needs to support the development of effective and efficient processes. Example fulfilment structures developed with healthcare professionals are presented, and reactions and benefits described by such professionals considered.

The approach described here is unlike other quality tools (for example, affinity diagrams, matrix diagrams, tree diagrams) that have been introduced over the years which have been defined primarily as tools that can aid the specific quality improvement process. These are essentially aimed at improving systems in place, and/or maybe the identification of areas where new systems might be needed, or they are used alongside traditional processes to support and inform system development. The approach described here reflects that the highest quality levels in electronically based fulfillment systems in healthcare can indeed be best achieved where an integrative approach to system design is applied throughout the system visioning, processes specification, and detailed design process. There have been many documented failures of large ICT and electronic fulfillment systems especially in the public and health sectors (see for example Heeks et al., 2000) where the perception was that the design processes were unable to cope with the system complexity, the diverse and sometimes competing objectives held by different stakeholders, and multiple political agendas surrounding the service. Further work has characterized some of the major reasons for failure in actual applications, for example Mosse and Sahay (2005) specifically identified communications problems, while other work highlighted the messiness and complexity that must be overcome in any successful application - Martin et al. (2004) identified the typical lack of consistency, coherence and integration of terminology, information and processes that must be overcome and reconciled to enable project success. They further asserted that it is important to acknowledge that the business of system configuration is the major design task. In these terms, the highest possible quality is likely to be achieved where:

those responsible for strategic system development have, from the start, a clear view of what the new systems are intended to achieve in terms of all stakeholders' needs;

- that these visions or expectations can be articulated and communicated to those responsible for detailed system development;
- that in fulfillment process specification, business process managers can visualize the emerging processes against the strategic objectives; and
- that those responsible for detailed ICT system development have a clear picture of the business and service processes to be delivered and how they interact.

This paper has followed the principle that to provide the best process systems to support a 'quality' healthcare provider, it is essential to engineer in quality as early as possible – effectively at the specification and design of the electronic transaction proposition phase. To achieve this requires a transparent model of how the structure delivers services and fulfils all stakeholders' needs; it must then be possible to link seamlessly to the emerging business model with the specification of the detailed service fulfilment processes and to the supporting ICT infrastructure. This paper has described such an integrating framework and the use of the triple-pair-flow construct to create prototype system structures, and concludes by evaluating this as a tool to support the creation of 'quality systems' to support the 'quality organisation'.

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