The implementation of ERP systems in Iranian manufacturing SMEs

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***Abstract* – The quest to implement Enterprise Resource Planning (ERP) software to support all main business functions has been actively pursued by in-house IT departments, software vendors and third party consultancies for over three decades. It remains a key element of many companies' information systems strategy in the developed world, and increasingly, in the developing world. In the specific context of Iranian SMEs, there has been relatively little research on information systems in general, and very little specifically on ERP systems projects. This paper attempts to help address this dearth in the existing literature by examining three case studies of ERP systems deployment in Iranian manufacturing SMEs. It investigates the underlying information systems strategies and examines how this has been implemented in the core process areas of these companies. The analysis is based on a conceptual model that combines defined implementation phases with change dimensions and elements, which provide the basis for the development of an implementation framework for subsequent ERP projects in this business and technology environment.**

Keywords – Enterprise Resource Planning; Total Systems; Iranian SMEs; information systems; ERP; process change; IS strategy; implementation framework.

I. INTRODUCTION

Enterprise Resource Planning (ERP) software packages first appeared on the market in the late 1970s and early 1980s, since when they have been widely deployed in the developed world, particularly by large corporations. Since the turn of the century, there has been an increase in the use of these integrated software systems by small to medium sized enterprises (SMEs) in the developed world. This has been paralleled – part cause, part effect – by an increase in the number of ERP vendors specifically geared to the requirements and budgets of SMEs. In the developing world, the uptake of these new systems has been slower, for a number of reasons, including the lack of the human and financial resources needed for such projects, and the non-availability of sales and support offices for many of the main ERP vendors operating in the developed world. Nevertheless, the use of ERP packages in developing world countries has accelerated in recent years, as evidenced by recent case study research [1], but the current literature suggests that there have been both significant failures [2] as well as some qualified successes [3][4].

One interesting development in Iran has been the emergence of integrated software solutions developed in the country, by and large for the home business market (Table I). These are sometimes called "Total Systems," being produced and sold by Iranian software companies. The term "ERP" is also used, but these products are usually more customizable than western based ERP products to specific user requirements, and are also available in both the Parsi language, as well as English. Although the sanctions on trade with the West have now been eased, Iranian companies tended to look within Iran for software solutions when these restrictions on trade were in place. This article examines the implementation of such packages in three Iranian SMEs and identifies the key factors involved in determining project

TABLE I. HOME GROWN ERP SYSTEMS PACKAGES IN IRAN (INDICATING VENDOR WEB ADDRESSES)

BEHKO	http://www.behko.com/?page_id=96
GREEN/ GALAX	http://www.greendataware.com/about/history/
PARS ROYAL	http://parsroyal.net/products
MEDAR GOSTARESH	http://www.itorbit.net/
HAMKARAN SYSTEM	http://www.systemgroup.net/products/%D8%B1%D8%A7%D9%87%DA%A9%D8%A7%D8%B1-%D8%AF%D9%88%D9%84%D8%AA
RAYDANA SYSTEM	http://www.danabarcode.com/
EADEGOSTAR	http://ideagostarco.net/Page/About
EADEPARDAZAN	http://www.eadepardazan.com/pages/ltr/LTRDefault.aspx?pid=2&lang=2
RAYVARZ	https://rayvarz.com/about-us
FARAGOSTAR	http://www.faragostar.net/automation/
PARNIAN PARDAZESH PARS	http://www.parnianportal.com/OA/Pages/Home.aspx
BARID SAMANEYE NOVIN	http://www.baridsoft.ir/products/integrated-approach/office-automation

outcomes. This analysis provides the basis for the development of a framework for successful ERP project implementation in similar business contexts. This introductory section is followed in Section II by a discussion of the relevant background literature. In Section III, a description of the case study methodology used in this research is given. Sections IV then reports in some detail on the case study findings, and Section V focuses on implementation issues and what can be learned from the case examples. Finally, Section VI makes some concluding remarks that pull together a number of themes discussed in the paper.

II. LITERATURE REVIEW

ERP is a modular but integrated software system which automates business processes, shares common data, and produces and accesses information in a real time environment. ERP software can be implemented in stages, module by module, and therefore be used to integrate previously isolated IT systems and functional departments within a company. ERP is also viewed by some researchers [5] [6] as a fundamental method for achieving best practice within business operations – the implementation of an ERP package requiring the application of certain disciplines within main business processes. As Koch has noted; "ERP attempts to integrate all departments and functions across a company on to a single computer system that can serve all those departments' particular needs" [5]. According to Turban *et al*. [7], ERP not only provides business discipline, it also allows the alignment of IT deployment with overall business strategy and business goals. Implementing ERP thus may also require change in core processes, often termed business process reengineering or "BPR" [8].

There remain divergences of opinion regarding the suitability of systems developed in the Western world in a developing world context. When discussing IS in the developing world, Gomez and Pather [9] observe that there is a lack of literature and evaluation studies, and the World Bank view that "analysts and decision makers are still struggling to make sense of the mixed experience of information technologies in developing countries" is highlighted by other authors [10]. In spite of some evidence of failure in the adoption of information systems (IS), the overall deployment of ERP and IS in general is increasing in the developing world.

Increasing professional skills and training is viewed as a key element for successful IS project delivery by Noudoosbeni *et al*. [11], who argue that lack of planning and management as well as inadequate training led to IS project failure in Malaysian companies. Research of companies in Iran [12] [13] [14] highlight a range of issues that have hampered IS deployment in general in the country - lack of managerial skills, low IT maturity, poor training, poor internet access, governmental policies, and poor business planning; but there is very little literature on the more specific issues faced by SMEs attempting to implement ERP software. Other researchers [15] [16] suggest that the lack of human capability and economic conditions in developing countries lead to IS failure and prevent overall economic growth. There nevertheless appears to be a significant market for ERP software in SMEs in the developing world. The studies of Dezar and Ainin [17] and Arabi *et al*. [18] indicate that 90% of businesses in developing countries are SMEs; but adoption of ERP systems by SMEs in developing countries is a relatively recent undertaking, in part due to the high expense and technical complexity of such systems.

Iran is an interesting example of the potential of ERP systems in a developing world country. Talebi [19] reports that the great majority of businesses in Iran are micro, small and medium-sized enterprises. According to Molanezhad [20], the majority of SMEs in Iran are in the manufacturing sector. He also suggests that due to the location of Iran in the Middle East, its access to Russia, Europe and Asia, and its considerable market size, ERP systems have significant potential in supporting Iranian SMEs grow their business and increase their employment. This potential has been reinforced by the recent international agreement on nuclear development in Iran, and the subsequent opening up of trading with the West. Hakim and Hakim [21] assert that "IT, as a new industry in Iran, has not found its rightful place within organizations, as the managers are still adamant and adhere to the traditional management systems, and show resistance to the required organizational and infrastructural changes".

Research by Heeks [22] suggests there are several main elements of change that are important in implementing new IS in developing world environments. He identified people, process, structure and technology as key dimensions of what he termed the "design-actuality gap". Heeks' model can be used in various business change contexts, and in this paper it is used to support the analysis of the implementation of the integrated software systems in the case study companies. Other authors [6] have adopted a similar approach in looking at structures that are embedded in both packages and organisations in trying to assess the reasons for misalignments between IS strategy and the overarching business strategy of the organisation.

The process mapping technique can help assess systems deployment at process level. It generates a sequence of maps that are used in identifying the information systems that are used in defined business areas. While process mapping is used as a framework to identify the business processes and sub-processes, it can also be used as a point of reference for assessing the functionality of the information systems themselves. This "systems profiling" encompasses a review and assessment of functionality, reporting capabilities, user interface and soundness of the underlying technology [23].

There are a number of ERP and IS implementation models in the literature such as Saunders and Jones [24] Bancroft *et al*. [25], Ross [26], Markus and Tanis [27], Parr and Shanks [28] and Esteves and Pastor [29]. Most of these models identify and define a series of stages in the overall implementation process. For example, the model put forward by Markus and Tanis [27] has four stages: charter, project, shakedown and onward and outward. The Process Phase Model (PPM) developed by Parr and Shanks [28] consists of three phases planning, project and enhancement, each with

its own critical success factors. The planning phase refers to activities such as package selection, appointment of a steering committee and project team members, defining project scope, determining the implementation approach and allocating resources. The project phase encompasses a range of activities from module selection to package deployment and 'go live'. The model identifies five sub-phases including set-up, re-engineering, design, configuration, and testing and installation. The enhancement phase covers system repair and maintenance, and business improvement and transformation. Ross's [26] five-phase implementation model is similar, including design, implementation, stabilization, continuous improvement, and transformation phases. The ERP life cycle model of Esteves and Pastor [29] has six phases and four dimensions. The dimensions are the different elements of change by which the phases can be analysed. The ERP life cycle model phases are: adoption decision, acquisition, implementation, use and maintenance, evolution, and retirement. The dimensions in the model refer to process, people, product and change management.

Within this context, the study addresses the following research questions (RQs):

RQ1. What has been the nature of ERP systems projects in SMEs Iran, and what has been the underlying information systems strategy?

RQ2. What lessons can be learnt from the implementation process to help guide future projects to achieve successful outcomes?

III. Research Method

The case study is a widely used research method within business research. Bryman and Bell [30] argue that the case study is particularly appropriate to be used in combination with a qualitative research method, allowing detailed and intensive research activity, usually in combination with an inductive approach as regards the relationship between theory and research. The case study is also appropriate for a combination of qualitative methods, which is of particular relevance to this study of information systems in three SMEs, where mapping and profiling techniques are combined with questionnaire and interview material. Saunders, Lewis and Thornhill [31] argue that case studies are of particular value for explanatory or exploratory investigation, such as that pursued in this research.

The case studies under investigation are manufacturing SMEs in Iran. This article reports on the findings from three case studies, for which aliases are used because of confidentiality issues. The first case study is the Isfahan Bus Company, which was founded in 1985 as a family business in Najafabad in Isfahan province. The company designs, manufactures and sells a range of buses, vans and spare parts and currently employs 350 staff. The second case study is Electronic Transmission Systems, a company employing 160 staff which was founded in 1978, and is another family business in the Isfahan province. The company designs, manufactures and distributes electronic vehicles, E-bikes, differential transmission systems (for Pride, Nissan Jounior and Tiba engines), and pinion and gear differential systems and parts. The third case study is the Spare Parts Company, which was founded in 1998 as a family business in Tehran province. The company designs, manufactures and sells spare parts for commercial vehicles (trucks, buses, minibuses and vans) and currently employs 250 staff.

Data collection was undertaken through questionnaires, interviews, and documentary evidence. Yin [32] suggests that the utilisation of multiple sources of evidence is one way of increasing the construct validity of case studies. A detailed structured questionnaire was filled in by three respondents in the first case study, two in the second and five in the third company and follow-up interviews were conducted with the questionnaire respondents. The job roles of these respondents were:

Isfahan Bus Company

Head of IT: he was heavily involved in supporting the company's main departments in specifying their requirements and in the package selection process. In the implementation phase, he had regular meetings with department heads to monitor progress and make sure they understood the implementation process.

Head of quality control and engineering: he was on the project steering group (PSG) that was responsible for selecting and implementing the ERP solution. As main user and responsible for overall project quality, he represented individual departmental needs, and met with the head of IT regularly.

Head of commercial department: he worked closely with the head of IT in the selection and implementation processes, identifying and planning training for most of the staff.

Electronic Transmission Systems

Head of IT: he was involved in selecting the ERP package, but the final decision was made by the company director, based on the recommendation of the head of IT.

Head of human resources: he was not involved in the software selection process but played an important role in post implementation, in reviewing and proposing training needs for new systems users.

Spare Parts Company

Head of IT: he was heavily involved in supporting the main departments in specifying their requirements and was in overall charge of the project team. He was involved in package selection and all implementation phases.

Head of finance: he was on the PSG and was responsible for overall financial management of the project, and more specifically for implementing the financial module of the selected ERP solution.

Head of quality control: he was on the PSG that was responsible for selecting and implementing the ERP package.

Head of sales and marketing: he worked closely with the Head of IT in the selection and implementation processes, identifying and planning training for most of the staff.

Head of production: he was not involved in the software selection process but played an important role in post

implementation, in reviewing and proposing training needs for new systems users.

The questionnaire responses and follow-up interviews clarified the processes and sub-processes that are central to the companies' business operations, and allowed a mapping of current technology deployment in each process area. More specifically, the topics included in the questionnaire can be categorised as follows:

a) Company information: basic company data, company profile, size, operations and other general information.
b) Company processes: the company's main business processes and also the secondary processes (sub-processes within each main process area).
c) Information systems: the deployment of systems modules and any remaining legacy systems, and the underpinning technical architecture.
d) Current systems status: the functionality of the main information systems and general satisfaction levels in different departments that use them.
e) Problems and challenges: key problems or issues, both from a technical perspective and from the point of view of the end user; integration and interfacing of systems, report quality, systems performance.

Questionnaires and interviews were conducted in Parsi and have been translated into English.

IV. ERP DEPLOYMENT AND IS STRATEGY

This section will apply process mapping and systems profiling to the three manufacturing SMEs in Iran, with the objective of establishing the current use and functionality of ERP modules and other systems, and assessing the underpinning IS strategy.

Case Study 1: The Isfahan Bus Company (IBC)

IBC has six major top level business processes and a number of sub-processes. These are briefly outlined below, along with the information systems which currently support them (Figure 1).

The *manufacturing process* comprises three sub-processes: production planning and production, quality control, and engineering. Production planning is automated via the materials requirements planning (MRP) module of the BEHKO system. This systems module assesses the requirements for production against current company stock and suggests replenishment works orders for the appropriate dates and quantities to meet production requirements. The system takes account of current stock levels, outstanding orders, and minimum purchase order quantities. It will suggest a schedule of what should be made and when, what should be purchased and when, and current and future loading of production lines, by resource by week. This sub-process includes the bill of materials (BOM) function. When the MRP module receives an order, it will also create a list of required components to make that order. The MRP module also has additional forward planning functionality. It has the capability to plan requirements for meeting new orders and rescheduling existing orders.

In contrast, the quality control and engineering sub-processes are only partly automated. These sub-processes are supported by Microsoft Excel spreadsheets and an Access database to monitor, store and report upon key events and stock transactions. These include inspection and testing records, and inventory transactions for engineering parts.

The *sales and marketing process* is also supported by the BEHKO system. There are two sub-processes – sales management and marketing management, supported, respectively, by the BEHKO sales management module (that encompasses customer records, sales orders, price lists and quotation functions) and the BEHKO customer relationship management (CRM) module. A customer record includes customer details, customer status, and customer discounts, and is linked to the sales ledger which shows outstanding invoices and displays these along with other real time data from BEHKO so that sales and purchasing staff have a total up-to-date view of pertinent financial data for each customer. The sales order function allows the entry and editing of sales order information and the generation of sales reports. The quotation function allows the processing of requested quotes for business and the generation of quotation reports to send to customers. The BEHKO CRM module provides the systems functionality to manage and report upon sales contacts, prospects, existing customers and suppliers, in support of improved customer service and better information availability across the internal customer facing processes.

The *purchasing and procurement process* centres on purchasing management and related operations. Purchasing management is supported by the BEHKO purchasing module, which provides a full range of purchasing functions. After the MRP module calculates requirements to fulfil a works order, a purchase requisition is generated electronically to be accessed by the purchasing department and processed as a purchase order on the system; copies are also made available electronically to the finance department and processed as a purchase order on the system; copies are also made available electronically to the finance department. The BEHKO purchasing module generates unique supplier reference codes and provides purchase reports for each supplier. It also has the capability to assess suppliers' credit worthiness and overall supply performance, and also attach picture, voice or any other document to supplier files.

The BEHKO finance and accounting module supports the *financial management* process, recording and reporting the current sales order book (accounts receivable), purchase order book (accounts payable), outstanding purchase invoices and staff payments, alongside the company general ledger and cash management transactions. This system assesses current outstanding sales orders to raise sales invoice to customers, and matches goods received notes against purchase orders and purchase invoices. The module defines the financial period start and end dates and can accommodate a variety of foreign currencies and exchange rates.

The *logistics and distribution* process has three sub-processes - inventory management, primary distribution and aftersales services, and agency distribution. Inventory management is automated via the BEHKO stock control module. The primary distribution and aftersales services sub-process manages customers' orders to ensure customer delivery and post sales service. It is supported by an off-the-shelf after sales information systems package called SEVEN.

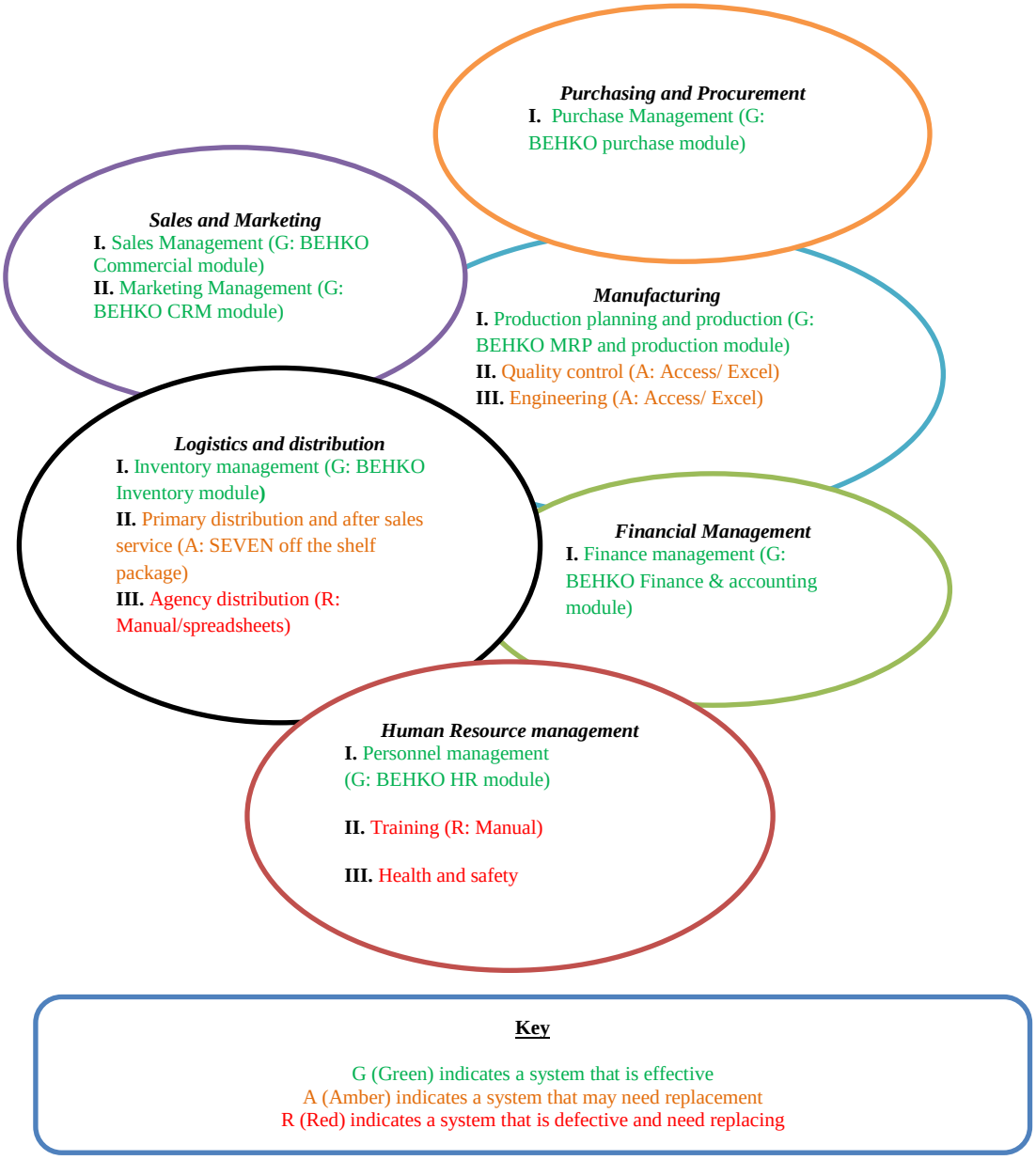

Figure 1. Main Business Processes and IS profiling at IBC

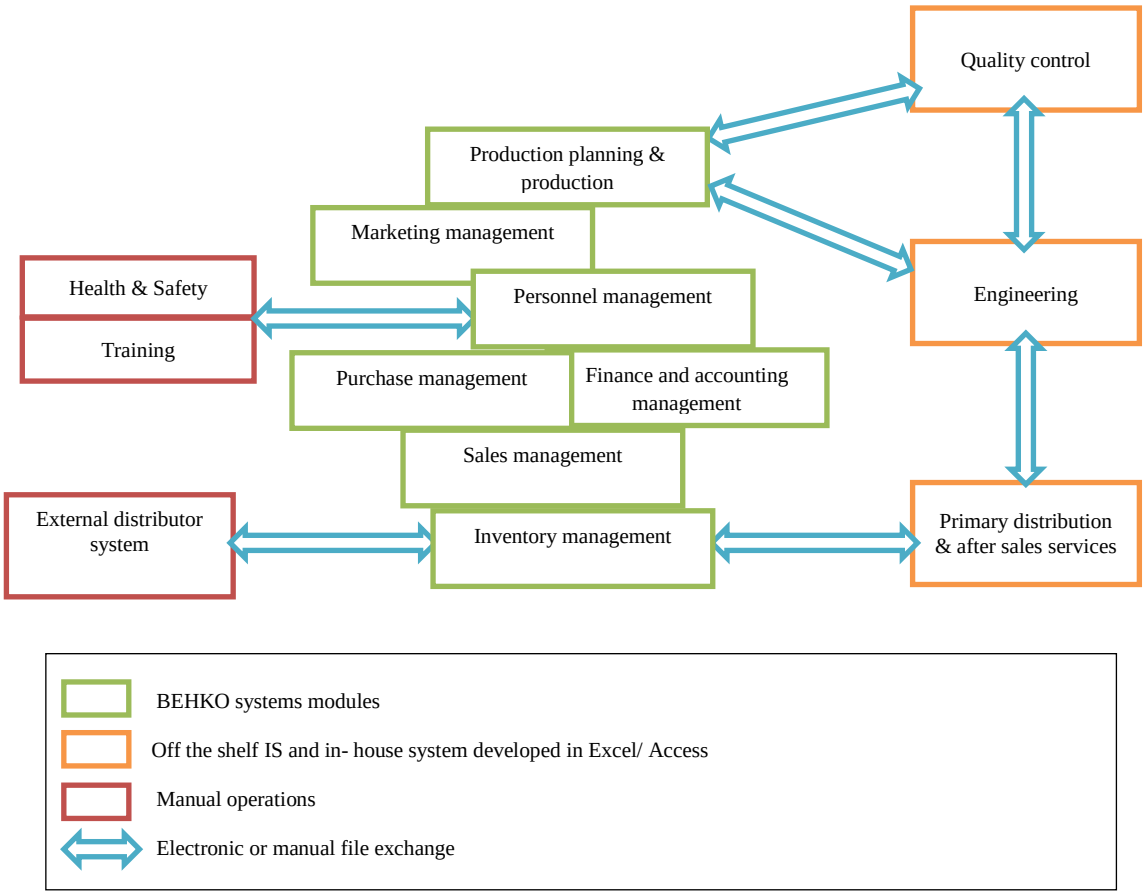

Figure 2. Systems Interfaces at IBC

The agency distribution sub-process involves the sale of spare parts for buses and other vehicles via company agencies located in different cities in Iran. This process is partly manual and partly automated by use of spreadsheets.

The *human resource (HR) management* process can be subdivided into three main sub-processes: personnel management handles employee records (including payment, staff absence and leave, and timesheet recording) and this is centrally managed and automated using the BEHKO HR systems module. There are also the staff training and health and safety sub- processes, which are mainly manual.

The information system strategy adopted at IBC has been to implement modules of the BEHKO total system in the core process areas of the business, some of which have been customized to meet the specific requirements of the company. BEHKO is an Iranian software company, and its selection was based on functionality, language – it uses both Parsi and English – and easy access for systems support and upgrade. IBC pursued a phased implementation to enable a careful phasing out of previous systems and a managed exchange of data between old and new systems. In addition, it allowed staff to adapt to the changes in systems and procedures in an orderly and controlled manner.

Many modules were customised based on requested requirements specified by senior management in each process area. In all, it took three years to implement the system, but even now some sub-processes are still manual or are supported by using spreadsheets and semi-automated file exchanges (Figure 2). Although the BEHKO system modules are well integrated, there is no effective integration with the stand alone SEVEN system, nor with the MS Excel and MS Access applications. The BEHKO system is developed in C++ and uses the SQL database and is administered by senior managers who have access to all system generated reports and invoices. These reports include key business performance information, providing an overview of all sales, purchases, stock levels, and financial data and staff reports.

IBC has five servers comprising a database server, software server, backup server, webserver (mainly for email), and antivirus server. Windows 2012 R2 is installed on all the servers as the operating system. Microsoft SQL 2008 was installed on the database server, whilst the BEHKO modules run on the software server. Database backup and vital files archiving are done on the backup server every day. In addition, IBC has installed the McAfee antivirus software on all desktop computers and all software

updates are managed by the antivirus server. The Internet connection installed in IBC is both wired and wireless. All departments are connected via an intranet that is controlled by privilege policy that manages the workflow. They follow a single sign-on technique; therefore, they have 100 desktops that are available to 100 or more users. IBC have also provided twenty portable devices (laptops) if needed by staff members for off-site working, or presentations and meetings. All PCs run under the Windows 10 operating system and have MS Office available. IBC uses a private VLAN and cisco switch to separate each server for higher security and privacy. The company uses firewall network security, located in three different physical areas, to prevent unauthorised access from other networks.

The current IS strategy at IBC was adopted in 2008 in support of the company's business strategy to expand production and drive up bottom-line company profit. The strategy was a formal decision made by a committee comprising selected managers from across all departments - commercial, finance, production, engineering, quality control, and the IT manager. Previous systems were a mix of off the shelf packages and end-user applications. The initial focus was in the logistics and distribution process area, to establish consistent inventory product codes and simplify and standardise product information for both internal processes and also for customer facing sales and marketing departments. After a successful six month parallel run of old and new systems in this area in 2008, the BEHKO systems modules were introduced in stages, completing in 2012. The software vendor continues to provide support and upgrades, and IBC is now planning a major upgrade to the BEHKO ERP product in 2017. This package includes improved functionality which should allow the replacement of the SEVEN package and other standalone applications.

Case Study 2: Electronic Transmission Systems (ETS)

Initial process mapping suggests there are six top level business processes, and each process has several sub-processes. The processes are depicted in Figure 3, along with the information systems which currently support these business processes.

The *manufacturing process* comprises three sub-processes: quality control, production planning, and production and assembly. The quality control sub-process encompasses the inspection of both purchased and manufactured parts and products, and the recording and monitoring of test results. The GREEN/GALAX quality control module records and manages all data associated with product sampling, testing and results recording and reporting. Security aspects are supported by systems controls on access, allowing only staff with the required skills and competence levels to undertake inspection testing.

The production planning sub-process is automated with the GREEN/GALAX materials requirements planning (MRP) module, which determines the quantity and timing of component purchases. MRP stores the bills of materials and explodes these into requirements, based on received orders, and will then compare the demands to available company stock to generate necessary procurement requirements. The production and assembly sub-process encompasses production control and final inspection operations. The GREEN/GALAX production module also provides time estimates for parts delivery at production line and for final inspection of finished products. The production team can attach drawings of product designs and technical specifications to job sheet records.

The *inventory management* process covers stock control and is partly automated with MS Excel spreadsheets monitoring manufactured and component products in and out of the stockrooms. The *product design* process is automated with a range of off-the-shelf design and planning software packages, including Catia V5R18, MSC Super Forge, Master CAM 9.0, Autodesk Mechanical desktop 2007, Power Mill 6.0, Primavera Project planner, MS Project 2007, and Minitab 13.0. This process encompasses the design and drawing of company products based on received orders and customer specifications.

The *commercial management* process has two sub-processes - customer management and supplier management – and both are supported by the GREEN/GALAX commercial management module. This module supports the categorization and management of both customers and suppliers, and recording of relevant details. The *financial management* process is similarly supported by a GREEN/GALAX module. There are two sub-processes: accounts management, and general ledger/asset management. The system manages financial activities, financial figures and reports and invoices; it contains the ledgers for sales and purchase transactions, and records company assets, liabilities, owners' equity, revenue, and expenses.

The *human resource management* process covers personnel management, including employee records, staff absence and leave, and timesheets. The process is mainly manual. Employees have their own identity and attendance card, which are checked and monitored by security guards at the company entrance. Annual leave is also authorised and recorded by a manual, paper-based system.

The information system strategy adopted at ETS is based on the GREEN/GALAX ERP package, combined with point solutions developed in MS Excel. The choice of the main software system again was influenced by the fact that it was available in the Parsi language and there was easy access to software support and technical advisors.

The current IS strategy was adopted in 2014 and was a formal decision made by the IT manager in conjunction with the company director. Modules of the GREEN/GALAX ERP were implemented simultaneously in core business functions in the period October to December 2014. The company has two servers - a database server and a webserver, the Windows 2012 R2 operating system having been installed on both of these. Microsoft SQL 2008 was installed on the database server, on which database back up is scheduled daily, in addition to offsite back up. GREEN/GALAX modules, website and email run on the webserver. Wired and wireless Internet access is installed. They have 25 desktop computers that are available to 27 or more users. ETS provides three portable devices (laptops) if needed by staff for off-site working, presentations or meetings. All PCs run

under the Windows 10 operating system and MS Office is used for personal productivity tools and email. The GREEN/GALAX system was developed in C++ and uses the Microsoft SQL 2008 database. The GREEN/GALAX system has a drop list that enables the user to choose which subsystem they wish to access based on their department and login. All users log onto the system with personalised user IDs and passwords allowing different accesses and privileges. This is controlled by thee head of each department who can grant users with additional or restricted access and permissions.

Unfortunately, training was poor and insufficient and there have been significant user issues with some departments reverting to previous semi-manual processes. There also remain a number of file exchange operations whereby data is extracted from the GREEN/GALAX system and input into standalone applications for inventory management and product design (see Figure 4). In 2015, external consultants were engaged to review the status of the ERP project and specifically to provide training and user support. Despite this initiative, there remain significant issues to address. The implementation of new modules has not been adequately coordinated with changes in people capability. The HR system needs to be automated and integrated with finance and the accounting department to prevent duplication and data inconsistencies in payroll. Similarly, the inventory management module of the GREEN/GALAX system needs to be ushered in to provide consistent product codes and enhance the capability and functionality of company business activities. The company needs to address the training issue to encourage and support staff in using all of the available functions in the new system.

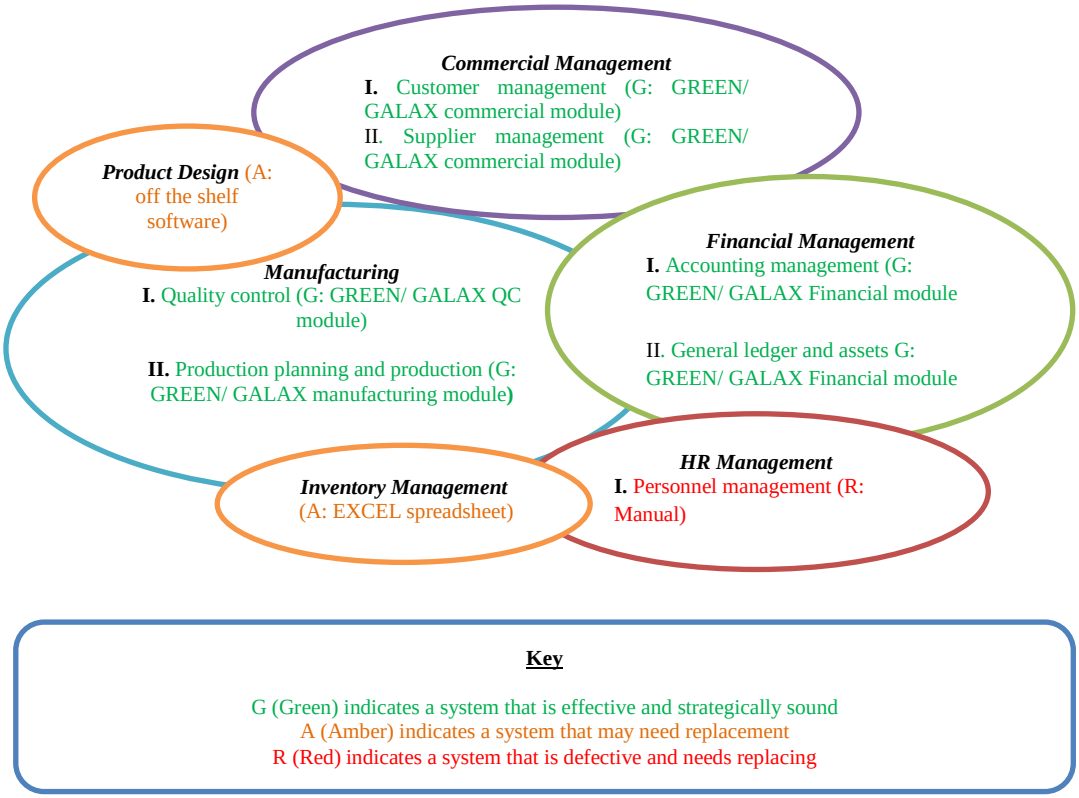

Figure 3. Main Business Processes and IS profiling at ETS

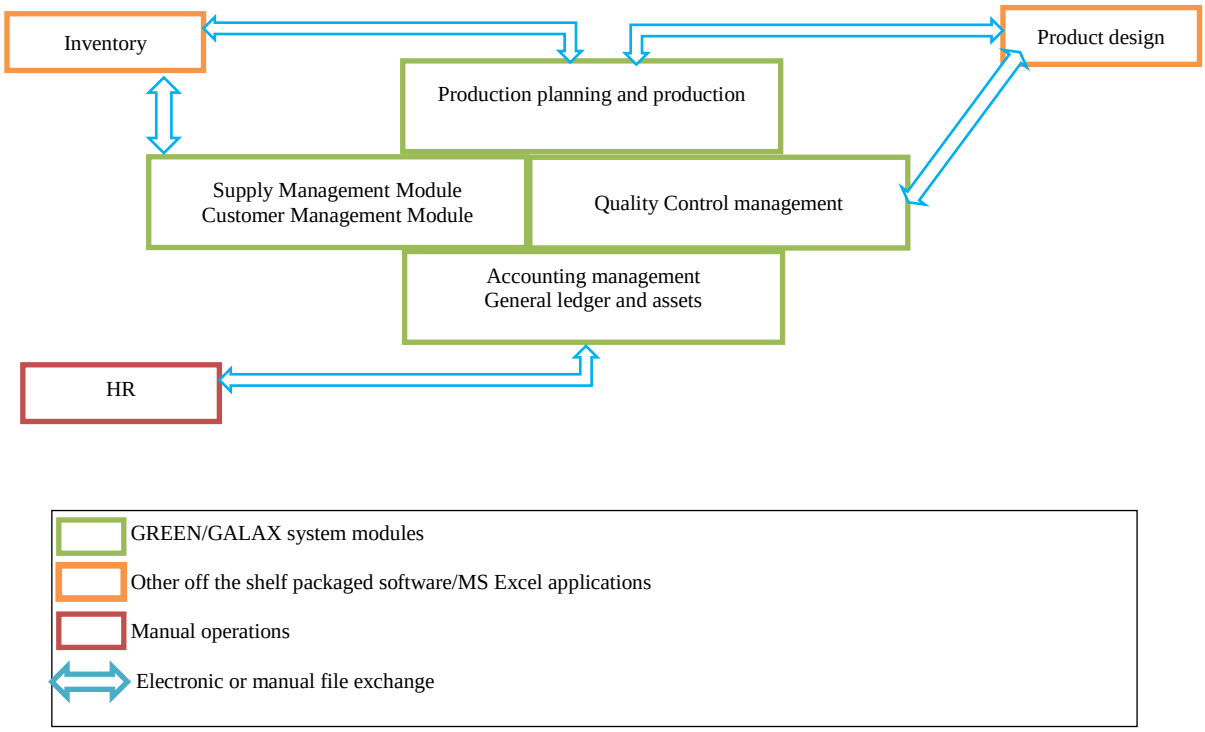

Figure 4. Systems Interfaces at ETS

Case Study 3: Spare Parts Company (SPC)

Initial process mapping suggests there are five top level business processes, and each process has several sub-processes. The processes are depicted in Figure 5, along with the information systems which currently support these business processes.

The *manufacturing process* in this company comprises two sub-processes: production/production planning, and maintenance/engineering. Production and production planning are supported by HAMKARAN manufacturing and operations module. The production/production planning sub- process reacts to forecast demand to generate works orders and procurement requirements to meet those orders. Users are also able to specify cumulative lead times they want to allow for order fulfilment, and also record human resource availability patterns for production. Users also record quality inspection details and outcomes across the internal supply chain from component parts to finished products. The maintenance and engineering sub-process, however, is only partly automated with Microsoft Excel spreadsheets.

The *sales and marketing process* is automated and supported by the HAMKARAN sales and marketing modules. This allows data entry and recording of relevant details for prospects and customers, price lists, and quotations, and reporting and tracking of sales orders, despatches and outstanding invoices, and the monitoring of credit control status of customers and sales performance. The sales team can change product prices and apply discount for specific customers or products.

The *financial management* process is automated using the HAMKARAN finance and accounting module, which is closely integrated with the other HAMKARAN modules. The finance and accounting module is used to prepare financial reports in compliance with Iranian accounting standards and international financial regulations. Standard reports are available from the general ledger, accounts payable, and accounts receivable, including evaluation of payment and cash discount histories.

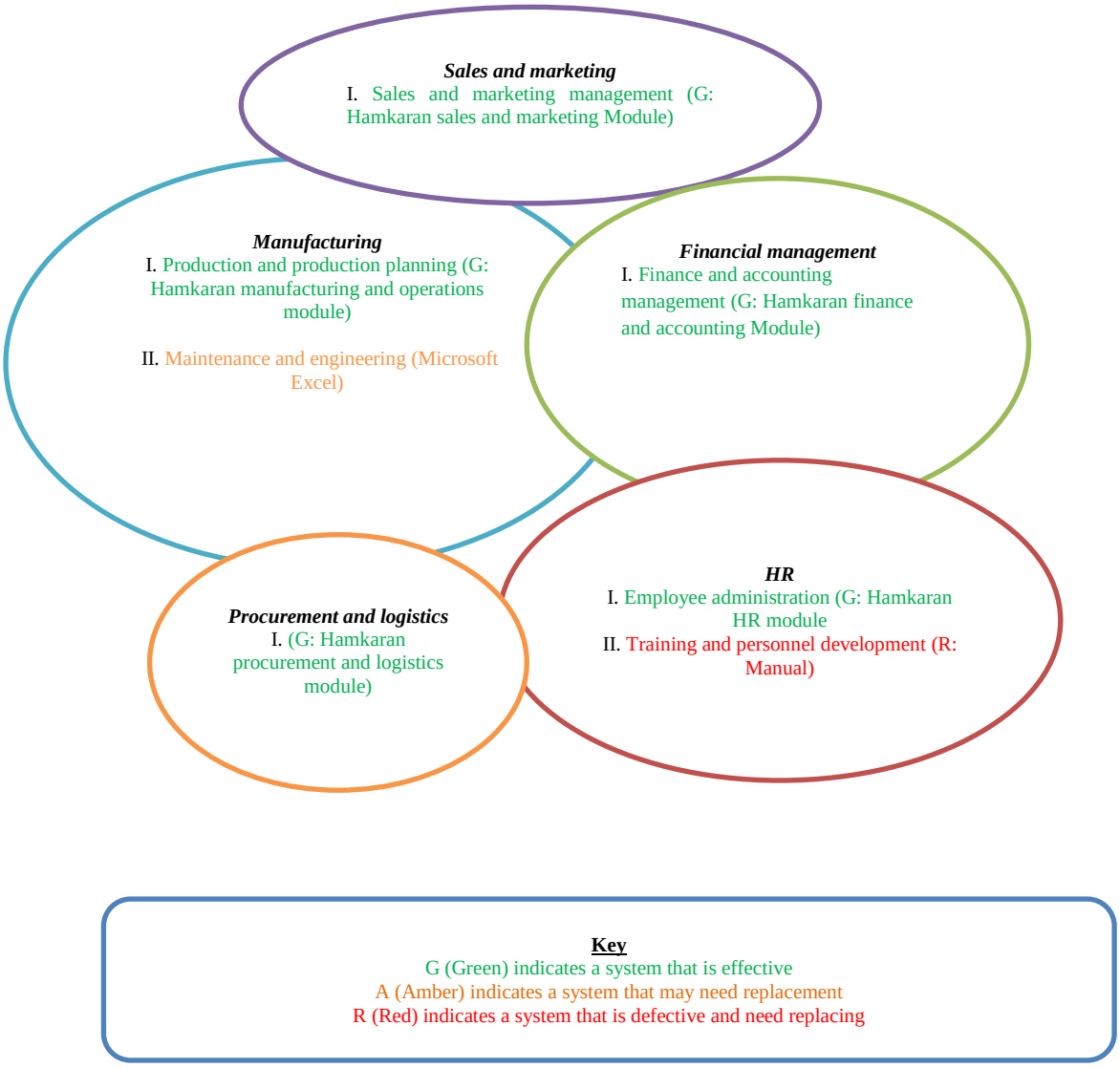

Figure 5. Main Business Processes and IS profiling at SPC

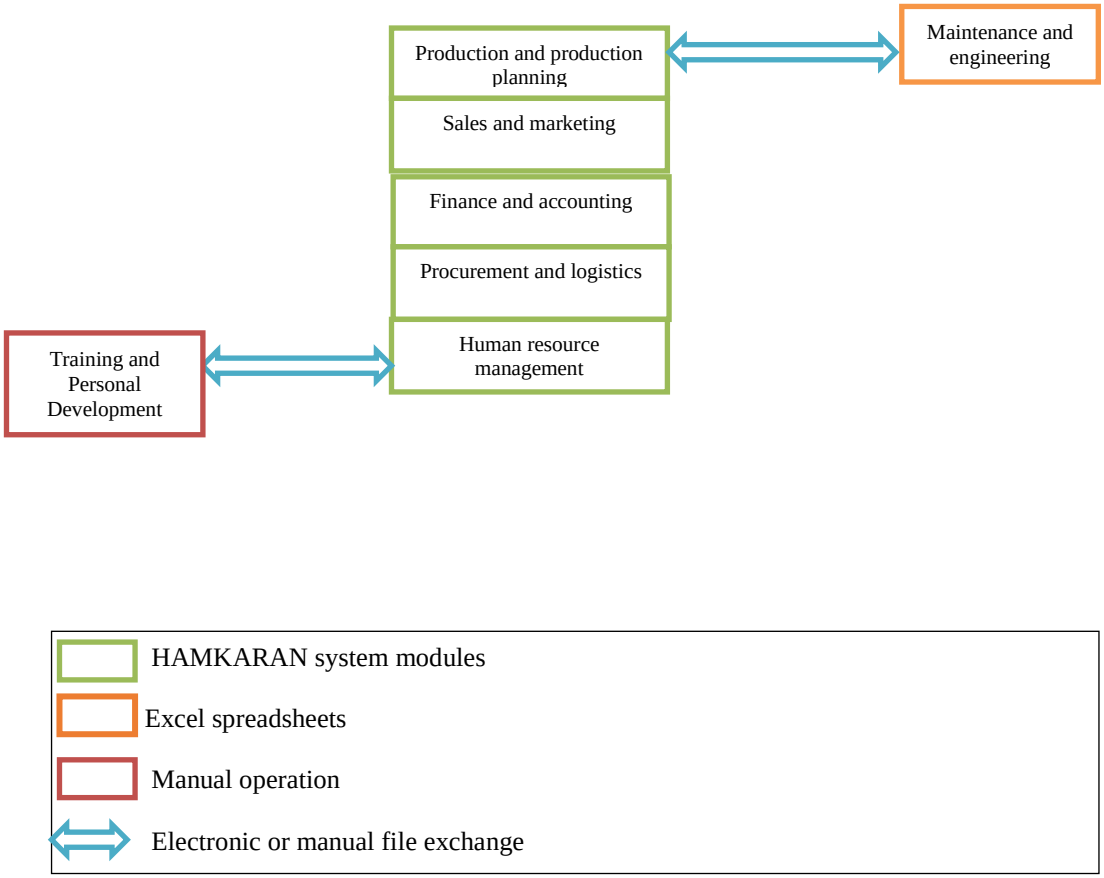

Figure 6. Systems Interfaces at SPC

The *human resources process* has two sub-processes - employee administration, which is automated with the HAMKARAN HR module, and training and personal development, which remains a manually recorded operation. The HR module includes full employee records, payment details, holiday and absence recording and payslip generation. It also has a full payroll function that integrates with production time records.

The *procurement and logistics process* encompasses inventory, purchasing and distribution management which are integrated and automated via the HAMKARAN procurement and logistics module. Once a works order is raised and MRP has calculated requirements based on available stock, a procurement request is processed through the HAMKARAN procurement and logistics module to produce purchase requisitions and purchase orders. This module also has functionality to support both inward and outward distribution, generating reports of expected deliveries against customer orders, and also reporting on finished product distribution.

The information system strategy adopted at SPC has been based around the phased introduction of the HAMKARAN ERP system. HAMKARAN is an Iranian product and the selection was again influenced by language (it uses Parsi), and availability of the Parsi calendar within the system. It also uses mainstream technologies, having been developed in C++ and Asp.Net (3.5/4.0) and runs on the Microsoft SQL server data base. SPC has four servers consisting of a database server running Microsoft SQL, a software server (on which are installed modules of HAMKARAN system), a web and email server, and a backup server. The Windows 2012 R2 operating system is installed on all servers, and the IT manager backs up the data from various servers on a weekly basis. Network connections installed in SPC are both wireless and cable, and all departments are connected via a local area network (LAN). All users have their own specific privileges which are determined by heads of department, and the privileges and accesses of heads of department are authorised by the company director. There are 50 desktop computers for 50 users, besides three portable devices (two laptops and an IPad) for off-site undertakings. All desktop computers run under the windows 10 operating system and have MS Office installed.

Another factor that influenced software selection was ease of access to the software company for software maintenance or upgrades. SPC elected to pursue a phased implementation to allow employees to adapt gradually to changes in their systems and ways of working. All modules were installed simultaneously in 2011 on a few desktop computers and the database server, and some key users were trained up in the use of the system. Systems modules were then installed on other desktops and users trained accordingly. Only then were some users put live, but this was done in phases and followed the order of the training programme. The financial systems users were first to use the new system, followed by manufacturing process users, sales and marketing, procurement and logistics and finally human resources users. Overall this roll-out and move to 'go live' took 4 months in the period November 2011 to February 2012. The project as a whole – encompassing the three phases as depicted Figures 5 and 6 – took an elapsed time of about 18 months spanning 2011-12. The HAMKARAN systems modules are integrated, but links with the Excel spreadsheet in the maintenance and engineering process is still done by file exchange. Nevertheless, the new ERP is now bedding in reasonably well, with the efficiency benefits of automating former manual processes now being delivered.

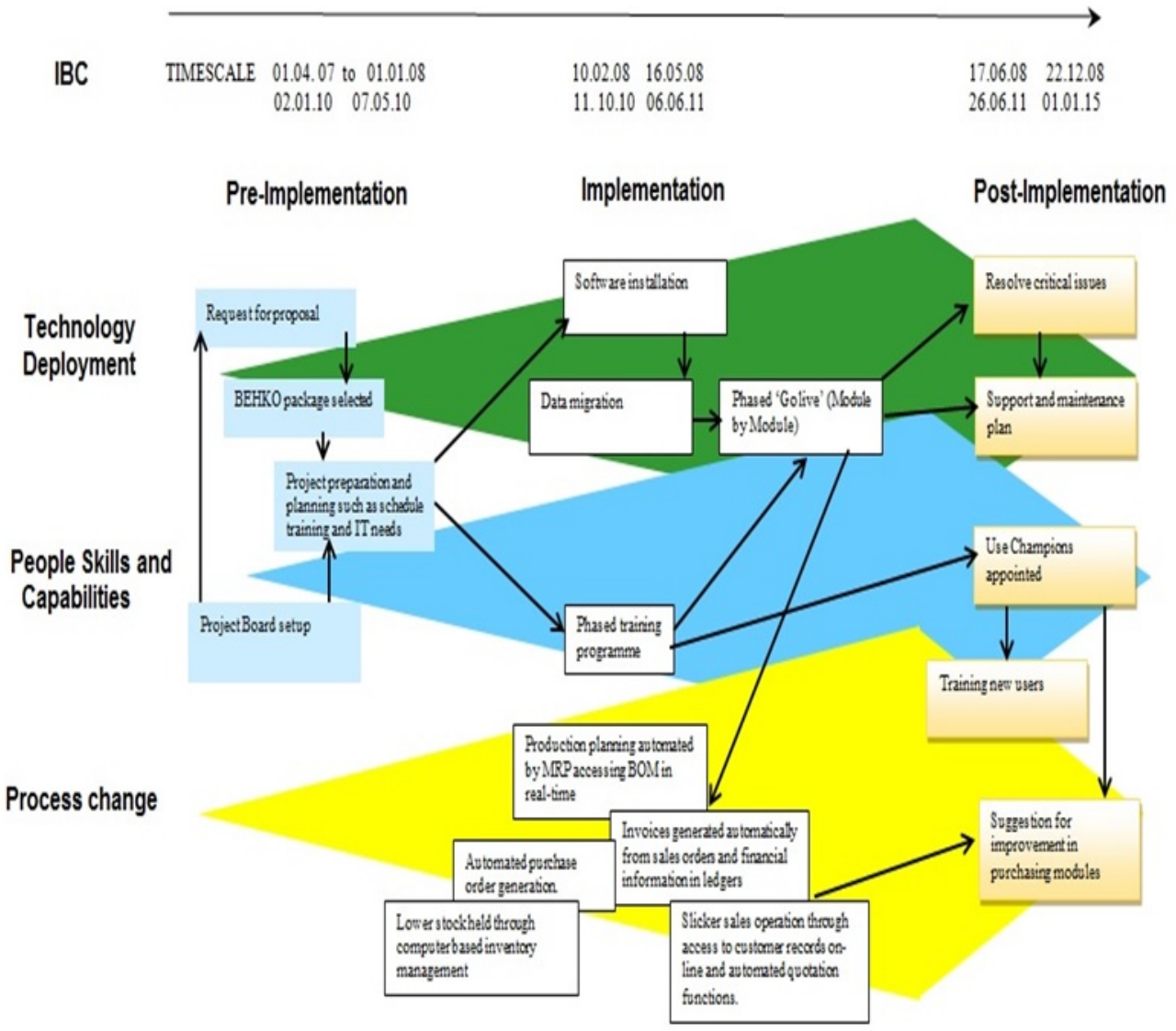

Figure 7. ERP Implementation at IBC

V. IMPLEMENTATION ISSUES

The current information system strategies at all three companies have some similarities. They all elected to adopt an ERP package from Iranian based software suppliers, to provide the benefits of integrated systems and consistent management information to support company growth aspirations. In all three companies, however, some of the old legacy systems remain in some core process areas, and these are likely to be replaced in the near future with appropriate ERP systems modules.

There were significant differences between the three companies' strategy implementation approaches. At IBC, the strategy development and its implementation was agreed to, and guided by, a cross-departmental steering group that carefully managed a phased implementation of the BEHKO ERP product, providing the necessary training and support for end-users. At ETS, the GREEN/GALAX ERP package was selected as a result of discussions between the IT manager and the company director, and lacked cross-company involvement and support. Implementation was simultaneous in most process areas, increasing the risk of systems problems and data issues. This was compounded by the absence of adequate training and support for end-users, which left the project in a parlous state. Only recently has the engagement of third party support helped to provide much needed training and bed in the new systems modules. At SPC, a phased implementation of the HAMKARAN ERP was successfully undertaken, the project spanning 2011-12

This analysis reinforces the findings of Heeks [22] and other recent studies [33][34][35] that suggest large scale technology implementation, even in SMEs, must be accompanied by appropriate process improvement and an upgrade in people skills to accommodate the new ways of working that are often introduced with new systems modules. There are a some elements of people change that affect ERP implementation throughout the project duration - employee skills (IT and computer literacy), awareness of goals and objectives, appropriate selection of project team and project board, identification of main users (including system champions) and clarity on their responsibilities and roles, planning and training, and having an effective project manager. The people change dimension had a very significant impact on the other dimensions of change (process and technology) in all three cases. Project team and project board decisions at IBC and SPC regarding package and module selection, customisation (at IBC), implementation strategy, and the organisation of the training programme impacted the project positively. The influence of competent project manager(s) is equally important. At IBC and SPC, project managers worked closely with the companies' IT managers - a combination of internal managers who knew the business and external managers who were expert in ERP positively affected project outcomes in a number of ways (such as technology decisions regarding IT infrastructure, implementation strategy, package selection).

Awareness of goals and objectives of the project and a willingness to broadcast them to users to involve them in all stages of the ERP project influenced the implementation process at IBC and SPC. By involving users throughout the project, they were motivated to work as a team. Involving users and sharing the goals and objectives developed a shared perspective with management and fully engaged them in the ERP project. By contrast, at ETS, the gap between top managers and the main users was detrimental to the whole project. The management style was in many ways typical of the Iranian private organisation culture, and put the project at risk. The majority of SMEs in Iran are private family businesses, managed by the owners, who make most of the decisions regarding such projects. This can act against the likelihood of overall project success which requires that all employees buy into the chosen solution and the implementation process.

Manufacturing SMEs in Iran need to be prepared for the process change challenges that are inevitable during a successful ERP project. Businesses should be prepared to modify their processes to fit the ERP system if necessary. The potential misalignment of current business processes with the business model underpinning the ERP system can increase the need for customisation, which negatively affects other project factors, resulting in potential budget cost overruns and exceeding the project timeline. It is important for SMEs in Iran to define their business processes clearly before selecting their package. The case studies also highlight the importance of communication across various stages of implementation. Communicating and sharing goals, objectives and process change plans encourages users to accept these changes and reduces resistance.

This is best illustrated at IBC (Figure 7), where a carefully managed implementation was done department by department, in parallel with a phased training programme for managers and key users. The role of the cross-departmental steering group was critical in guiding the project through a number of key activities, from the request for proposal from ERP suppliers, to the selection process itself, through the phased implementation, the conduct of the training programme and to the final agreement of a support and maintenance plan. It is the project at IBC that perhaps best illustrates a model for future ERP projects in similar companies in Iran.

VI. CONCLUDING REMARKS

The case studies of the implementation of three home grown ERP products in Iranian SMEs revealed some interesting results. These ERP products are structured in a similar manner to their western counterparts, albeit they appear to allow greater flexibility in customisation to specific users' needs. The projects were generally successful, being the product of a fairly straightforward IS

strategy of replacing old manual and legacy systems with new ERP modules. At ETS, however, there is still a need for more training to ensure the system is used effectively and owned by the users themselves. The implementation process was a little different in the three cases, and the successful outcome at IBC suggests a phased approach is likely to be most successful in which people change elements (steering group, project leadership, training and skills upgrade) are put in place in parallel with technology implementation.

The case studies also provide some interesting insights into the ERP market in Iran, where, with international sanctions now lifted, the opportunities for western based ERP vendors are likely to be enhanced. However, the home-grown ERP (Total Systems) packages have an established user base which is likely to grow, in the short-term at least, given the benefits of customisation and operation in the Parsi language that most of these packages offer.

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