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ADAPTING ERP REQUIREMENTS TO IDENTIFY AND CLASSIFY WASTE-RELATED SOFTWARE FROM SOFTWARE LISTINGS

INTRODUCTION

One of the biggest challenges to recycling, remanufacturing, disassembly and waste management businesses lies in their reliance on manual data management systems, such as Microsoft Excel. These systems provide very limited automation, decision support and relevant features. Cost and availability are the two biggest barriers to larger software acquisition, with the availability and marketing considered in this study.

Enterprise Resource Planning (ERP) systems are typically large systems that cover all business processes from material sourcing and inputs, production, management and outbound logistics. While ERP systems are normally targeted at larger corporations, their requirements are well-defined and can be adapted to the waste related domains.

IDENTIFYING REQUIREMENTS

ERP systems occupy a large role in businesses due to the automation of processes coupled with the reporting and decision support capabilities which are provided, which are immensely beneficial to waste-related businesses.

Key ERP requirements were identified from a typical list of ERP requirements (Rolland and Prakash, 2001). These features were grouped into four major categories for comparison with suitable sub-features (Table 1):

→ Financial and organisational management
→ Customer and supplier relationship management
→ Customisation and data processing
→ Manufacturing, inventory and material management

Table 1: ERP Features applied to software listings in the four waste-related domains

	ERP Feature	Waste	Recycling	Reman-ufacturing	Dis-assembly
Financial and Organisational Management	General Financial Management and Reporting	80,0%	83,3%	57,1%	90,0%
	Billing and Invoicing	82,5%	90,0%	71,4%	90,0%
	Customer Accounts	80,0%	83,3%	57,1%	90,0%
	General Human Resource Management	25,0%	26,7%	14,3%	10,0%
	Social Features	10,0%	13,3%	14,3%	10,0%
	GRI Reporting Capabilities	35,0%	40,0%	28,6%	20,0%
Customer and Supplier Relationship Management	General Customer Relationship Management	60,0%	73,3%	57,1%	50,0%
	Customer Database	67,5%	83,3%	57,1%	60,0%
	Customer Service Interface	62,5%	70,0%	57,1%	40,0%
	Supplier Sourcing and Management	60,0%	66,7%	57,1%	60,0%
	Creating Full/Partial Purchase Orders	62,5%	73,3%	71,4%	60,0%
Customisation and Data Processing	Legal Compliance/Reporting	62,5%	63,3%	57,1%	50,0%
	Data Format Customisation	35,0%	36,7%	28,6%	20,0%
	Modularity	47,5%	46,7%	14,3%	30,0%
	Data Importing	20,0%	23,3%	14,3%	10,0%
	Data Exporting	30,0%	30,0%	14,3%	20,0%
	Data Quality Management	32,5%	30,0%	14,3%	20,0%
	Custom Query Support	32,5%	33,3%	28,6%	20,0%
	Known Database Connectivity	20,0%	16,7%	28,6%	10,0%
Manufacturing, Inventory and Material Management	General Production Process Management	32,5%	43,3%	14,3%	30,0%
	Health and Safety regulations	42,5%	50,0%	42,9%	50,0%
	Production Scheduling Inventory Quality Management	42,5%	53,3%	14,3%	30,0%
		42,5%	50,0%	14,3%	50,0%
	Information about Components	12,5%	23,3%	28,6%	20,0%
	Asset and Capital Management	30,0%	50,0%	28,6%	30,0%
	Waste Disposal Reporting	62,5%	63,3%	42,9%	80,0%
Sample Sizes		40	30	7	10

SAMPLING AND ACQUISITION

Businesses typically acquire software by accessing onling listings. This study simulated this behaviour by consulting the relevant listing websites that index and advertise software offerings. Four websites were investigated with 166 software offerings extracted and indexed (Table 2). Duplicate entries were removed resulting in 52 unique software packages that were purchasable or accessible in the first half of 2016. These sampled software offerings were compared to the ERP requirements identified previously and comparatively analysed with regards to feature availability and support.

Table 2: Software Listings with relevant filters. Listing size indicates unique number of software packages for the filters applied

| Listing Name	Filters Applied	Listing Size
Capterra – Recycling, Remanufacturing (http://www.capterra.com/recycling-software/)	Disassembly, remanufacturing, recycling	15
Capterra – Waste Management (http://www.capterra.com/waste-software/)	Waste management	60
Recycling & Waste World (http://www.recyclingwasteworld.co.uk/)	Disassembly, recycling, waste management	8
Environmental Expert (https://www.environmental-expert.com/)	Disassembly, remanufacturing, recycling, waste management	83

SOFTWARE CHALLENGES
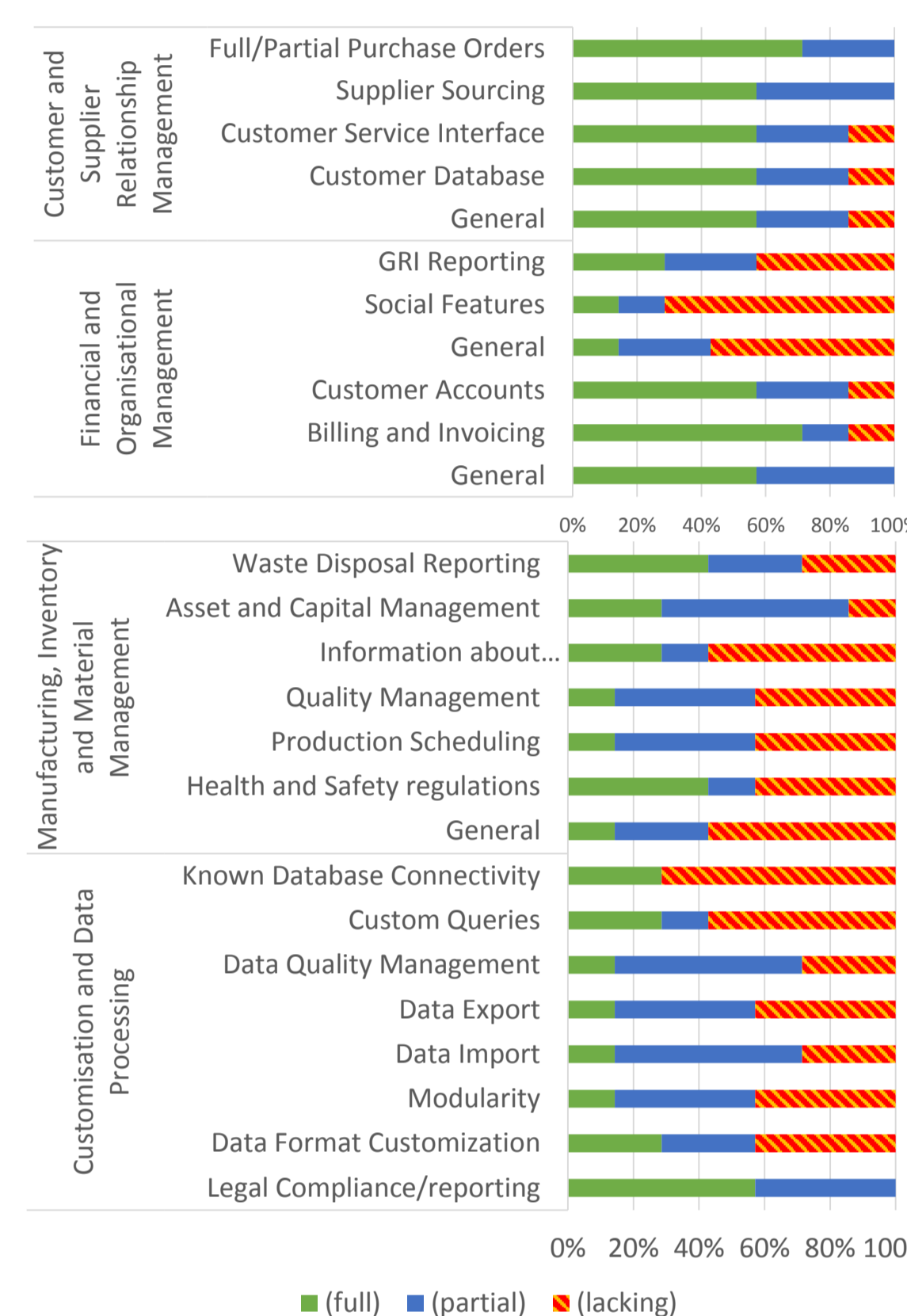
Figure 1: ERP Features applied to remanufacturing software

When comparing the ERP feature criteria to the available features in the software offerings indexed on the waste-related listings, various challenges become apparent:

→ Social features (integration with popular social media for B2C or B2B communication) are lacking in all domains
→ Data import and export features are near-absent in all domains which is challenging for software pipelines and compatability
→ Material and product composition information capabilities are low, resulting in businesses being unable to record material and product composition for more effective recycling and dismantling
→ Modular software design is not strongly supported in all domains
→ General ERP features, such as HR and asset management are missing, despite many of the software packages being based on ERP packages

Examining the remanufacturing sub-domain closer (Fig. 1), the data processing and reporting features are notably lacking, such as custom queries and reporting, as well as integration with the known remanufacturing databases which contain useful and real-time information.

DESIGN RECOMMENDATIONS AND OUTLOOK

Software design recommendations derived from the findings in this study are:

1. Provide higher levels of data management and integration to support importing, exporting, customization (especially between countries) and provide stronger reporting features
2. Product and material composition is a key knowledge factor for the waste domains (DEFRA, 2014). This feature must be centrally supported to be aligned with the domain specific requirements
3. Production processes should be coupled with reporting processes at a software level to provide sustainability and compliance reporting
4. Software advertised on software listings should be updated more regularly with pricing information, which was not found readily when indexing

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