International Journal of Industrial Ergonomics 68 (2018) 118–124

Contents lists available at ScienceDirect

International Journal of Industrial Ergonomics

journal homepage: www.elsevier.com/locate/ergon

Optimal approaches to the quality control checking of product labels

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ARTICLE INFO

Keywords:
Quality control
Visual inspection
Human error

ABSTRACT

Quality control checkers at fresh produce packaging facilities occasionally fail to detect incorrect information presented on labels. Despite being infrequent, such errors have significant financial and environmental repercussions. To understand why label-checking errors occur, observations and interviews were undertaken at a large packaging facility and followed up with a laboratory-based label-checking task. The observations highlighted the dynamic, complex environment in which label-checking took place, whilst the interviews revealed that operatives had not received formal training in label-checking. On the laboratory-based task, overall error detection accuracy was high but considerable individual differences were found between professional label-checkers. Response times were shorter when participants failed to detect label errors, suggesting incomplete checking or ineffective checking strategies. Furthermore, eye movement recordings indicated that checkers who adopted a systematic approach to checking were more successful in detecting errors. The extent to which a label checker adopted a systematic approach was not found to correlate with the number of years of experience that they had accrued in label-checking. To minimize the chances of label errors going undetected, explicit instruction and training, personnel selection and/or the use of software to guide performance towards a more systematic approach is recommended.

1. Introduction

Ensuring the quality of packaged fresh produce is of paramount importance at all stages along the supply chain, from grower to supermarket retailer. A vital aspect of this quality control process is to ensure that the printed labels on the produce packaged by packaging facilities are in complete accordance with the specifications stipulated by the supermarket customer. If the label information is not accurate, then significant financial, environmental, and reputational costs will be incurred by both the supermarket and packaging company. Indeed, the cost to the United Kingdom (UK) supermarket industry of label-checking errors is estimated at £8–10 m per annum (S. Hinks, Product Technical Manager: Fruit and Floral, Sainsbury's Supermarkets Ltd, personal communication). Broadly speaking, quality control label-checking can be considered a type of visual inspection task (e.g., Drury, 1993, 2006, 2015), in which products are checked by eye by human operatives to verify that they meet the required specifications. Visual inspection has been studied across a broad range of industrial and manufacturing settings (e.g., Drury, 1993; Jameeson, 1966; Melchore, 2011; Rao et al., 2006; Rebsamen et al., 2010; Wang and Drury, 1989; Wang et al., 1997). However, to the best of the authors' knowledge and with the exception of some preliminary work (Katz et al., 2015; Smith-Spark et al., 2015), label-checking has not been explored previously. The aims of the research reported in this paper, therefore, were to understand how professionals involved in quality control checking actually checked fresh produce labels for errors and to identify whether an optimal approach to label-checking existed. In order to achieve these aims, observations were undertaken in a large-scale packaging facility and interviews were conducted with key quality control operatives. The knowledge gained from the observations and interviews were then used to inform the design of a simulated label-checking task presented to professional label checkers under laboratory-conditions. Before reporting the findings of the field and laboratory work, it is necessary first to set the label-checking task in context. It is thus to a description of the fresh produce packaging process, and quality control thereof, that this paper now turns.

1.1. The fresh produce packaging and labelling process

Supermarket chains place weekly orders for fresh produce by contacting the commercial office of the packaging facility. These orders may specify particular varieties of a fruit or vegetable, designated UK

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https://doi.org/10.1016/j.ergon.2018.07.003
Received 6 June 2017; Received in revised form 28 June 2018; Accepted 9 July 2018

and overseas growers, and promotional offers. This information is entered into a specification sheet for circulation within the packaging facility. The entries on the specification sheet are checked by two members of the commercial team against the communication from the supermarket customer. After checking, the specification sheet is released to staff across the packaging facility, with updates being published as required during its week-long lifespan.

Errors can, and do, occur in the information entered onto the specification sheet by the commercial office but the pack-house was identified by the facility's management as the priority for investigation. Industrial processes and cognitive behaviors in the pack-house were thus the focus of the remaining work reported in this paper.

The pack-house is where the fresh produce is packaged for transportation to depots and, from there, supermarkets. It is a large-scale operation dealing with over 170 fresh produce Stock Keeping Units (SKUs) a day, and its operation is made even more complex by having to factor in variations in the size, variety, and grower of the produce when packaging the orders. Study of the packaging facility records held by the packaging facility highlighted both the high volume of orders (e.g., 1316 label runs on stone fruit alone in March 2014) and the disproportionate effect of a very small number of label errors eluding quality control checking. Indeed, fewer than 1% of orders contained errors and, of this 1%, less than 5% go undetected during quality control checking (i.e., approximately five in every 10,000 label runs contain errors that go undetected).

Each production line in the pack-house has a number of operatives supervised by a team leader. The team leader consults the specification sheet and generates the order of fresh produce to be delivered from the facility's warehouse. There are several kinds of packaging machine in use on more than 40 production lines in the pack-house (see Fig. 1), built by different manufacturers and running various types of software to package fresh produce in different ways (e.g., in plastic punnets, polythene packets or nets). All types of packaging require the presentation of label information to accompany each unit of the packaged product. The specification sheet is the sole source of information from which operatives in the pack-house work when packaging the fresh produce to meet the orders placed by the supermarkets. It provides the information to populate the fields of the label to accompany each unit of the packaged produce, such as best before date, weight, and country

Fig. 1. The pack-house floor.

Fig. 2. An example of a fresh produce label. Like all the stimuli used in the study, this label contains seven bits of information (product name, country of origin, grower, quantity, best before date, barcode, and a promotional ribbon/label).

of origin. Where labels are not printed directly onto polythene film, the team leader of the production line must complete and submit a label order form to the packaging facility's print room, specifying the information to appear on the printed label. The print room then uses this information to produce a run of labels in line with these specifications and commensurate with the size of the order. The labels are then collected by the team leader who distributes them to the production line operatives to append to each packaged unit.

Depending on the type of produce, each label contains a certain number of fields of information, including details such as the type and variety of produce, the best before date, the name of the grower, the country of origin, the barcode, and the weight or quantity of the produce contained in the packaged unit. In addition to the label, a further sticker or ribbon may also be attached to the packaged product. This "flash" label highlights any current promotional offer on the product and also needs to be quality control checked. An example label with an accompanying flash label is shown in Fig. 2.

1.2. The occurrence of label errors

Due to the complexity of the printing and packaging systems, the availability of particular varieties of fresh produce, and the last-minute nature of some orders from retailers, a technological solution involving full automation of the label production process was not deemed feasible or cost-effective by the packaging company. Instead, the labelling process involves an operative using software to input information from either pull-down menu options or via an alphanumeric keyboard. As a consequence, human error results, occasionally, in mistakes occurring in the information printed on labels.

Errors can occur in any of the label fields, although the likelihood of an error occurring is higher in some fields (i.e., those requiring data entry by a human operative) than in others (e.g., the barcode). These error types range from spelling errors (e.g., relating to the name of the grower of the product) to variety errors (e.g., a variety of grape being stated that differs from the product actually contained in the packaging) to quantity errors (e.g., relating to the number of items contained in the packaged product) through to those with serious implications, be they financial (e.g., stating "Buy one, get one free" instead of "Buy 2 for £2"), health-related (e.g., giving the incorrect best before date), and/or legal (e.g., being labelled as "British grown" but originating from another country).

1.3. The quality control checking process

Each production run undergoes quality control checks by several