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Work instruction quality in industrial management

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ABSTRACT

Employees who must rely upon poor quality work instructions are less efficient and have lower job satisfaction. Thus, it is in most companies' interest to avoid this type of situation. However, a literature review revealed that literature on work instruction quality is sparse. To address this issue, this paper proposes a framework for understanding information quality of work instructions in industrial management contexts. The framework includes 15 dimensions of work instructional information quality problems, which are grouped into five categories: intrinsic problems, representational problems, unmatched information, questionable information, and inaccessible information. To illustrate the relevance of the framework in an industrial management context, studies of two engineer-to-order companies were carried out. The studies revealed that the companies experienced problems related to all 15 dimensions. The framework may be used as a guide for industrial managers who wish to avoid instances of employees performing work based on poor quality instructions.

1. Introduction

If employees have to base their work upon poor quality work instructions, they are less efficient, make more errors and have lower job satisfaction (Conner and Douglas, 2005; Lind, 2008; Oakland, 2011). Thus, it is in the interest of companies to avoid this quality inadequacy. But in order to avoid poor quality information in instructions, it is necessary to understand what this kind of quality refers to. However, literature has not dealt much with this topic, for which reason it is not clear exactly what instructional information quality is. To answer this question, this paper proposes a framework, which defines relevant types of information quality in relation to work instructions. The framework is structured within an industrial management perspective, which implies a focus on instructions related to design procedures, operating machinery, producing components, assembling of components, handling deliveries, service inspections, after sales, use of technology, etc. However, the usefulness of the framework may not be limited to this context.

It has been argued that poor data/information quality in companies can have significant negative economic and social impacts on an organization (Wang and Strong, 1996; Ballou et al., 2004). More specifically, poor quality data/information is claimed to have negative effects such as less customer satisfaction, increased running costs, inefficient decision making processes, lower performance, and lowered job satisfaction (Redman, 1998; Pipino et al., 2002; Kahn et al., 2002). It has also been argued that poor quality data/information is a common phenomenon, and that even small data inaccuracies can have large effects (Redman, 1998; Häkkinen and Hilmola, 2008; Marsh, 2005). However, such literature focuses almost only on types of 'factual information', which can be contrasted to 'instructional information' (Floridi, 2010, p. 34).

In relation to work instruction quality, studies show that this is a significant problem in many industrial contexts. This includes studies of work instructions in relation to aircraft maintenance (Patel et al., 1994; Drury, 1998), process-control plant maintenance (Garrigou, 1998), chemical plant operations (Bullemer and Hajdukiewicz, 2004), process reengineering at a teleoperator and a truck manufacturer (O'Mahoney, 2007), railway operation and maintenance (Holmgren, 2005), shipping safety (Oltedal, 2011), automotive assembly line operations (Huang and Inman, 2010), and hearing aid design processes (Sickel et al., 2011). In the worst case, poor quality work instructions can lead to fatal accidents. This is demonstrated by the study by Lind (2008), which investigates accidents in industrial maintenance in the Finnish industry and links 63% of the fatal accidents and 38% of the non-fatal accidents to defective work instructions.

As opposed to the topic of work instructions, related topics such as 'learning theories' and 'information/knowledge management' have received more attention in recent years. However, in the context of engineering companies, addressing instruction quality

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problems with theories of learning or information sharing can be an inefficient approach. The learning perspective is problematic because, in many cases, the main focus of instruction processes is not to help someone acquire (learn) new skills or knowledge. Rather, the purpose of giving instructions is often to provide someone with a description of what to do or how to do it, while the intention is not that the provided information should be recalled after use. Obviously, it is more efficient for production personnel to assemble a unique product based on stepwise instructions rather than internalizing (learning) this information before beginning the assembly work. The knowledge sharing perspective is also problematic because the aim of an instruction process is not to share the knowledge of the instruction sender but, rather, to ensure that the instruction recipient acquires the information needed to carry out the task in a satisfactory manner. By perceiving the process of providing instructions as a knowledge sharing process, the focus may shift towards making the recipient understanding the "world" in the same manner as the instruction sender. Thus, this perspective will inevitably imply that information not strictly required to carry out the particular task is shared, for which reason the process becomes longer. For example, although a designer or an engineer understands why certain components are chosen and why they should be assembled in a particular manner, such information is not needed for those conducting final assembly; they only need to know which components to pick from stock and how they should be assembled.

The focus of this paper is on work instructions in a broad sense, which includes instructions delivered in both verbal form (words communicated orally or in writing) and non-verbal form (pictures, images, models, gestures, etc.). However, regardless of the communication form, poor quality instructions need more processing than high quality instructions before the task in focus can be carried out. High quality instructions refer to more than the correctness of the instructions, but also to unambiguousness, completeness, meaningfulness, etc. For example, if an instruction appears ambiguous, is incomplete or includes terms not clearly understood, the employee needs to reason, guess, or gather additional information to figure out what to do. To avoid these outcomes, there is a need to understand what information quality means in relation to work instructions. Thus, this paper answers the question:

Which types of information quality are relevant in relation to work instructions in industrial management contexts?

The remainder of the paper is structured as follows. Section 2 conducts a literature review on information quality and work instructions. With a basis in the literature review, Section 3 derives relevant information quality dimensions in relation to work instructions. Section 4 describes empirical investigations of the framework. The paper ends with a conclusion in Section 5.

2. Literature review

The literature review of this paper consists of three parts. The first two parts focus on clarifying the concepts of 'information' and 'information quality', and a structured review on 'work instructions' follows.

2.1. Information

The terms data and information (and sometimes even knowledge) are often used interchangeably. However, a distinction can be made. According to Floridi (2011, p. 83), the commonly used definition of 'information' in research fields related to information science and information systems is "data with meaning" (or context). According to Floridi (2011, p. 84), this General Definition of Information (GDI) can be formulated as a tripartite definition (subsequently explained):

1) Semantic information consists of n data, for $n \geq 1$
2) The data are well-formed (syntax)
3) The well-formed data are meaningful (semantics)

In the first clause, the term 'semantic information' is used. The reason why this term is used by Floridi (2010, p. 32), instead of merely 'information', is to distinguish this kind of information from 'environmental information'. Environmental information refers to the possibility of meaning being given to data independent of an intelligent producer/informer. An example is the rings in the wood of a tree (i.e. a non-intelligent informer), which may be used to estimate the age of the tree. In the second clause, the term 'well-formed' refers to the data being organized according to the rules of the system, code, or language in focus. Thus, this concerns syntax, which refers to the combinatorics of the units of a language without considering their meaning. In this context, syntax should be understood more broadly than linguistics, as "what determines the form, construction, composition, or structuring of something". For example, engineers, film directors, painters, chess players, and gardeners use the term 'syntax' in this broad sense (Floridi, 2011, p.84). In the third clause, the term 'meaningful' refers to data which comply with the meanings of the chosen system, code or language, i.e. semantics.

In spite of the widespread use of the GDI defined above, some theorists argue that this definition is too loose and that a 'truth' element is required. One example is Dretske (2008, p. 29), who gives the example of being told about train arrival plans. If nothing you are told is true, this in fact implies that you have not been given any information about the train arrival plans, but merely misinformation. As Dretske (2008, p. 29) states "… misinformation is not a kind of information anymore than decoy ducks are a kind of duck". However, Dretske (2008, p. 30) acknowledges that there may be special purposes, for which the distinction between information and misinformation should be ignored, but in order to build a theory of information, the distinction is necessary. In this vein, Floridi (2011, p. 93) states that although the expression 'false information', linguistically speaking, is both common and perfectly acceptable, it is problematic. Floridi (2011, p. 93) provides a long, logical arguments for a 'truth' element being needed in the GDI and, thus, concludes that instead of 'false information', it is better to talk about 'misinformation' or 'pseudo information', which is not information. In this context, the common understandings of 'knowledge' may also be considered, i.e. in the explicit form as 'justified, truth(ful) beliefs' (Fuller, 2002; Newell et al., 2002) or, in the tacit form, as "the individual ability to draw distinctions within a collective domain of action, based on an appreciation of context or theory, or both" (Tsoukas and Vladimirou, 2001). More specifically, if information is understood as a basis for the creation of such kinds of knowledge, obviously, only truthful information is relevant.

In relation to work instructions, Floridi (2010, p.34) makes an important distinction between instructional and factual information. To illustrate the difference, Floridi gives the example of a flashing red light, which is a phenomenon that can be interpreted in both an instructional and a factual manner. More specifically, the flashing red light can be seen as a piece of 'instructional information' in the sense that the light flash conveys the need for a specific action, for example, recharging of a battery. The flashing red light can also be seen as a piece of 'factual information' in the sense that the light flash represents the fact that the battery is flat (Floridi, 2010, p. 34). Instructional information can be imperative (e.g. a