INTRODUCTION OF A KNOWLEDGE-BASED SYSTEM INTO EXTENSION SERVICES FOR PIG HUSBANDRY.

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Abstract: A field test was conducted on the introduction of a knowledge-based system into the extension service of a feed company. The objective was to gain experience in usage and to define critical factors for a successful introduction. Seven extension workers actually used the model and eleven used only the results. The pig model was used to advise the better performing pig producers at tactical decision level. This implies a limited use. During introduction, gaining confidence is essential, which can be obtained by gaining insight into the model. This is a slow learning process, which can easily be disturbed by, for example, absence of a help desk or lack of time.

Keywords: Knowledge-Based System, pig production, extension service, field test, evaluation research

1. INTRODUCTION

During the past few years, a wide variety of Knowledge-Based Systems have been developed. Only very few of them are used in practice. Hilhorst (1992) called the introduction of Knowledge-Based Systems into the market a risky enterprise.

In December 1993, a project, including a field test, started on introduction of a pig simulation model into the extension service of a feed company. Objective of the project was to gain experience in using a

Knowledge-Based System (KBS) in the extension service and to define critical factors for a successful introduction.

This paper first describes the role a KBS plays in extension and the design and results of the field test. This is followed by a general discussion about the introduction process of a Knowledge-Based System. Critical factors determining the success of such an introduction are indicated.

2. METHODOLOGY

2.1 Theory

The role a KBS plays in an extension service can best be explained by the communication model (figure 1). The model shows that communication is an indirect process; A (the source) sends a message or creates a signal from which B (the receiver) is able to obtain information. In our case, the extension worker selects information from sources (eg. KBS) and formulates advice for the farmer. The farmer selects information from this advice and other information sources, which in turn affects farm management and farm results. Figure 1 shows the importance of behaviour of the extension worker and pig farmer for the success of a KBS. Because of this, the evaluation of the field test is aimed at the factors determining their behaviour.

Behaviour is strongly related to the intended behaviour (Ajzen and Fishbein, 1980). The theory of the planned behaviour teaches that the intended behaviour is influenced by attitude, normative beliefs and perceived behavioural control (figure 2, accentuated part). Attitude is a person's own opinion about the behavioural consequences; normative beliefs involve the influence the opinion of relevant people have on their behaviour and perceived behavioural control means that the people believe that they are actually able to behave in that particular way. These three factors are all influenced by people's knowledge of the consequences of behaviour (Van Woerkum and Kuiper, 1995).

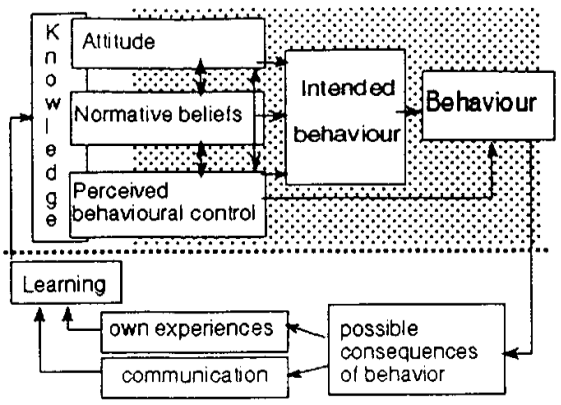

Fig. 2. Behaviour model according to Van Woerkum and Kuiper (1995).

2.2 Design of the project

The pig simulation model used in the project integrates all relevant knowledge of pig husbandry and climate and the impact on the technical and financial results. So far, the application of the model has been limited to research and product development. In the project the model was used by extension workers to advise pig producers

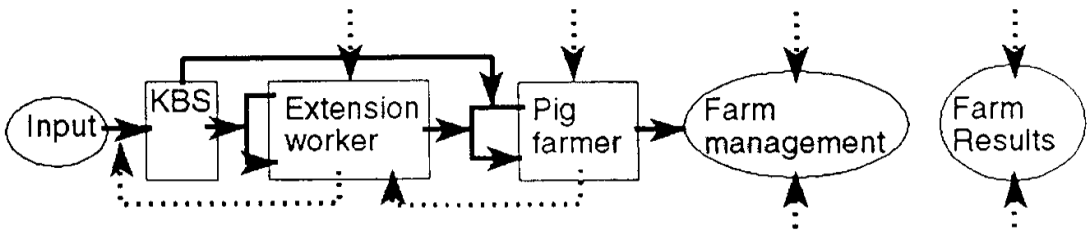

Fig. 1. Position of a Knowledge-Based System in a communication model.

on feeding programs for fattening pigs. The total project lasted two years and was divided into the following four phases:

Definition
By studying the literature and conducting a market survey of currently known KBSs in the Netherlands and an enquiry among about 60 extension workers of a feed company, a best case scenario was formulated for introduction of the pig model. By the enquiry the expected subjects of use and usefulness and requirements for the user interface were investigated. The concept for the knowledge system was based on a balance of functionality, user acceptance and transparency.

Product development
Based on the results of the enquiry, a new user interface for the pig model was developed. The new computer program has fewer options, but is easier in use and its comments are in dutch instead of English.

Field test
Seven extension workers (extension workers A) were selected for using the pig simulation model in the field test. These people were specialized in advice on fattening pigs and had had a one-day course on the simulation model. In the course the theoretical background of the model was explained. The model was demonstrated and an exercise had to be done. During the field test, a help desk was available and the extension workers had two more half-day courses.

During the field test, distinction was made between actual use of the pig model and of the results only. By this, the effect of actual use on behaviour could be indicated. In total, eleven extension workers (extension workers B) did not perform the simulation themselves but only collected the input data and used the results to advise pig producers. The KBS was used by extension workers A and B to advise 51 pig producers.

Evaluation
The opinion of the people involved in this project, especially of extension workers A, forms the basis of the evaluation. Attitude of these people, which is based on experiences, are more distinguishing and better predictors of future behaviour (Van der Pligt and De Vries, 1995).

To gain a better insight into the intention to use the pig model, enquiries were held among extension workers A and B and the farmers concerned. Subjects in the enquiries were the underlying factors of the intended behaviour (attitude, normative beliefs, perceived behavioural control and knowledge). For each subject, the enquiry consisted of several scale items. As an indicator for the relevance of each scale item, the Likerts method (Van der Pligt and De Vries, 1995) was used. To get insight into the mutual relevance of the subjects of the enquiry, a conjoint analysis of product attributes was carried out among extension workers A. By combining the results of the enquiry and the conjoint analysis, the intention to use the pig model was estimated for each extension worker A.

Besides the enquiries, the extension workers had to fill in a logbook for each farm with 18 questions about the simulations performed.

Extension workers A
The enquiry for extension workers A had the following subjects;

* Attitude
  - profit of use (1)
  - possibilities for use (2)
  - ease of use (3)
* Normative beliefs with respect to
  - the pig producer (4)
  - the colleagues (5)
* Perceived behavioural control
  - support by the company (6)
* Knowledge of and confidence in the model (7)

In total, the enquiry consisted of 85 scale items, which were put in random order.

After the enquiry, a structured interview was conducted together with a conjoint analysis of product attributes. The interview consisted of three parts:

* Characterizing the extension worker
* The determinants of behaviour
* The pig model and expected future use.

Extension workers B

The enquiry for extension workers B consisted of 54 scale items about the subjects 1,2,3(partially),4 and 7 of the enquiry of extension workers A. The scale items used were selected from the items of the enquiry of extension workers A. Besides the scale items, 15 open questions were asked about the determinants of behaviour and expected future use of the pig model.

Pig farmers

To categorize the pig producers according to their information need (Leeuwis and Jansen, 1994), the enquiry started with questions about the farmer's use of information. Next, there were 27 scale items about the following subjects;

* Attitude
* Normative beliefs
* Perceived behavioural control
* Knowledge of and confidence in the model

The enquiry concluded with questions about the simulation performed and expected future use of simulations.

4. RESULTS OF THE FIELD TEST

After the field test, all seven extension workers were willing to continue to use the pig model. However, during the field test, they had to be stimulated constantly to perform simulations. Because of this, the period of the field test was prolonged with a few months.

Motives of the extension workers for using the pig model were dissatisfaction with farm results, to indicate prospective alternatives and commercial reasons. The pig model is mostly used for calculating the exact outcome of alternatives but also for offering the pig producer something special or for convincing him of the usefulness of previous advice. Differences in considerations between extension workers A and B suggest that the the latter used the KBS mainly as a commercial tool and extension workers A as a technical tool (Table 1). Identification of the possible applications was also found more difficult by extension workers B. They ascribed this to a lack of knowledge of and experience with the pig model.

Table 1. Considerations for using the pig model.

consideration	A (n=25)	B (n=19)
exact calculation	19	6
something special	4	8
convincing	2	5

The pig model was mainly used for constructing an optimal feeding program for pigs, which confirms the fact that the pig model is used at a tactical rather than at an operational decision level. The expected use per farm, as indicated by the extension workers, will be limited to about once a year, according to the low frequency of advice at strategic and tactical decision levels (Hilhorst, 1994).

Using the pig simulation model cost extension worker A about 3 to 5 hours each time and was never done on the farm. The time required per simulation will decrease with increasing experience of the user and availability of input information.

The pig model was used by extension workers for fine-tuning advice on the better performing pig farms. These farms were well equipped and the farm manager aimed at improving farm management and was willing to make efforts in collecting data.

The average farm results of these farms were above national average. Estimates of the extension workers indicate that about one quarter of the clients will be suitable for using the pig model. By the learning effect for the extension worker, triggered by use of the pig model, the pig model can be beneficial to more pig producers.

If the pig simulation model was used, the pig producers mostly followed the advice. All 18 farmers who responded to the written enquiry, still knew the advice given and about 90% of them followed it. One out of 18 farmers lost confidence in the pig model. About 90 percent of the simulations were considered useful by the extension workers.

Although the extension workers did not expect the model to contain all knowledge of pigs, they were convinced that the model presented all relevant consequences of a change.

Table 2. Correlation between intended behaviour and subjects in the enquiry. (*: α=0.10; **:α=0.05)

	Intention	
profit of use (1)	0.8	(*)
possibilities for use (2)	1.0	(**)
ease of use (3)	0.4	
pig farmers (4)	0.9	(**)
colleagues (5)	0.1	
support by the company (6)	-0.1	
confidence in the model (7)	0.8	(*)

Points of intended behaviour of extension workers A are based on the weighed scores of subjects 1,2,3 and 4 (table 2). The significant positive correlation between intended behaviour and confidence in the model shows the importance of having confidence in the model in order to use it voluntarily. The opinion of colleagues does not influence the usage by the extension worker. The low correlation between intention and ease of use and support by the company can be due to improvements already introduced into the user interface and the availability of a help desk during the field test.

5. DISCUSSION AND OUTLOOK

Effective use of a KBS requires a high level of expertise on the part of the user. On the other hand, by using the pig simulation model, the user's knowledge of pigs increases.

Voluntary use of a KBS by extension workers will depend on the internal motives for using the KBS. For achieving internal motivation, the extension worker has to gain well-founded insights into the model and also confidence that the KBS is useful in the job. By achieving internal motivation based on profound knowledge, the behavioural changes are longer lasting and more permanent than changes only based on external pressure and stimulation (Van Woerkum and Kuiper, 1995). How an increase in knowledge results in a more stable intended behaviour, can best be explained by the theory of the planned behaviour placed in the context of the learning process and knowledge (figure 2). During this process of action and learning, the intended behaviour should develop positively. At the start of the introduction, knowledge of consequences of using a KBS is limited and the consultant will not recognize the usefulness of the KBS. In this phase, the intention has to be developed via learning by communication. The major objective of communication should be to develop the user's insight into the KBS and to form realistic expectations of the usefulness and results. When the extension worker starts using the KBS, the goal of the introductory course has to change into guiding the users into a positive direction. Negative experiences during this phase will impede further use

by the extension worker.

Adult learning is characterized by the demand for a quick application of newly gained knowledge and the need for integration in practice (Van Woerkum and Kuiper, 1995). This claim may conflict with the time required for introduction of the system. To reduce the time required for learning, use of a simplified KBS can be helpful. After introduction, the quality of the user interface is less important.

A positive intended behaviour based on little knowledge and few insights is weak and the intention should result in a smooth change to actual behaviour. For not disturbing the weak intended behaviour, the availability of a help desk and a good support by the organization are strongly recommended.

The use of a KBS for advice at a tactical or strategic level or the use when one's own knowledge is insufficient, indicates a possible limited use of the KBS. Therefore, use by specialists is recommended. Use of the KBS by specialized extension workers has the advantage that people can remain experienced and perform the simulations more quickly. Besides this, use can only made by motivated extension workers and the quality of the user interface is less important. For a good cooperation with colleagues, it is essential that they recognize the usefulness of the system and have realistic expectations.

For the acceptance of the outcome of a simulation by the pig producer, it is important that (s)he has confidence in the model. For not undermining initial confidence, the consultant should explain clearly what the simulation includes. This implies a realistic format of the output which reflects the quality of the model as well as the input information.

For continued use of simulation models in practice, an optimum balance between benefits and costs is necessary. This is especially related to decisions with respect to the exactness of the simulation, the farm specificity of the simulation and the quality of the input data.

Before introducing a KBS into the extension service, the management has to be fully aware of the costs and time required for introduction and the costs of developing the KBS.

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