Applications of Natural Language Processing

in KLM & Elsevier

Assisting Users to Provide Feedback by Asking Smart Follow-up Questions

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Fly Responsibly

Royal Dutch Airlines

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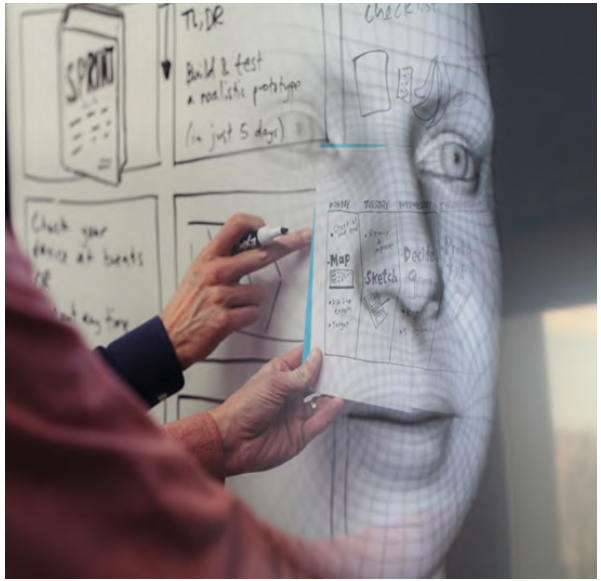
We realize value by experimenting with technology and transforming our way of working.



EXPERIMENTING

with new technologies and methodologies

- Blockchain
- Artificial Intelligence
- Robotic process automation
- Virtual reality
- Augmented reality
- Internet of Things

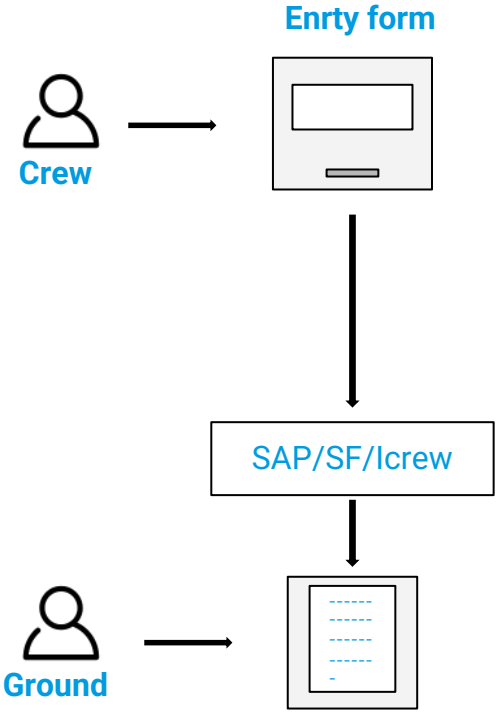
TripReports

Today, Crew and Ground are not able to use feedback sufficiently from **TripReports** to improve **operational excellence** & increase **employee engagement** due to having different systems to report and the difficulty of using them.

Current situation

Problems:
- UX problems
- Categorization
- No feedback

Garbage in

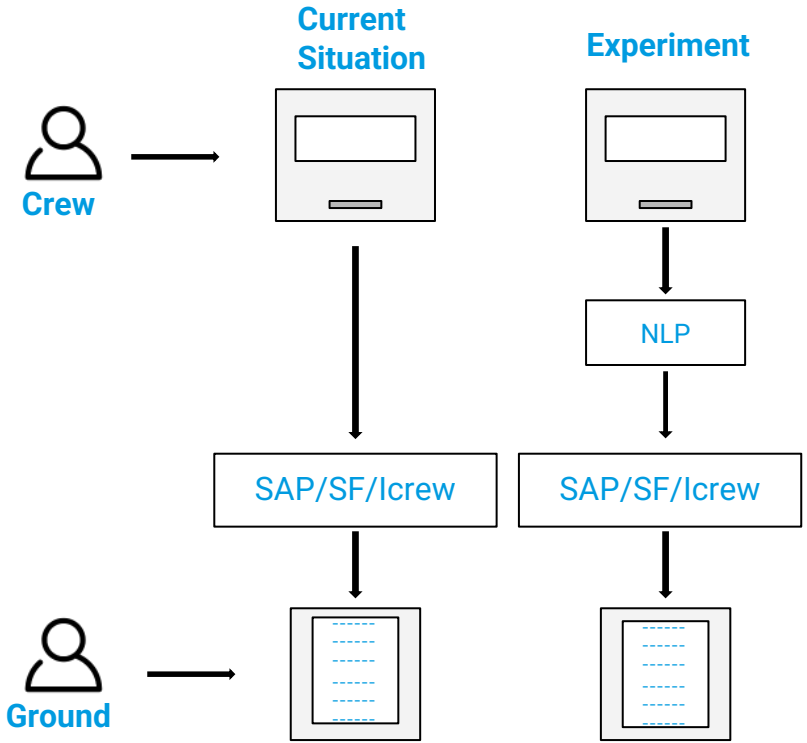


Problems:
- Missing info
- Wrong categories
- UX problems;
(processing, dashboard, reporting)

Garbage out

Our solution

Problems:
- UX problems
- Categorise
- No feedback
- **Garbage in**



Experiment Improvements:
- ☑ Improve entry form
- ☑ Better and automatic categorization;
  - simplify tree structure (1 tree)
  - NLP / text classification

Problems:
- Missing info
- Wrong categories
- UX problems; (processing, dashboard, reporting)
- **Garbage out**

☑ Feedback (only checkbox)

Experiment Improvements:
- ☑ No more missing information
- ☑ No more wrong categories

TripReport classification: challenges

- Large number of labels (more than 7000)
  - Different domains (hotel, catering, passenger, etc) have their own label set
- Labels have hierarchical structure
  - Depths differs per domain
  - Hierarchy implies subset relationship
    - Data skewed towards more generic labels

Tripreport classification: models

- Basic model
  - Flatten labels
  - Text representation: BOW, tf-idf on character n-grams
  - Model: SVM
- Hierarchical model
  - Train local classifiers for each branching point of the label tree
  - Local classifier models are the same as the basic model
- BERT-based model
  - Fine-tune a pre-trained BERT model for classification

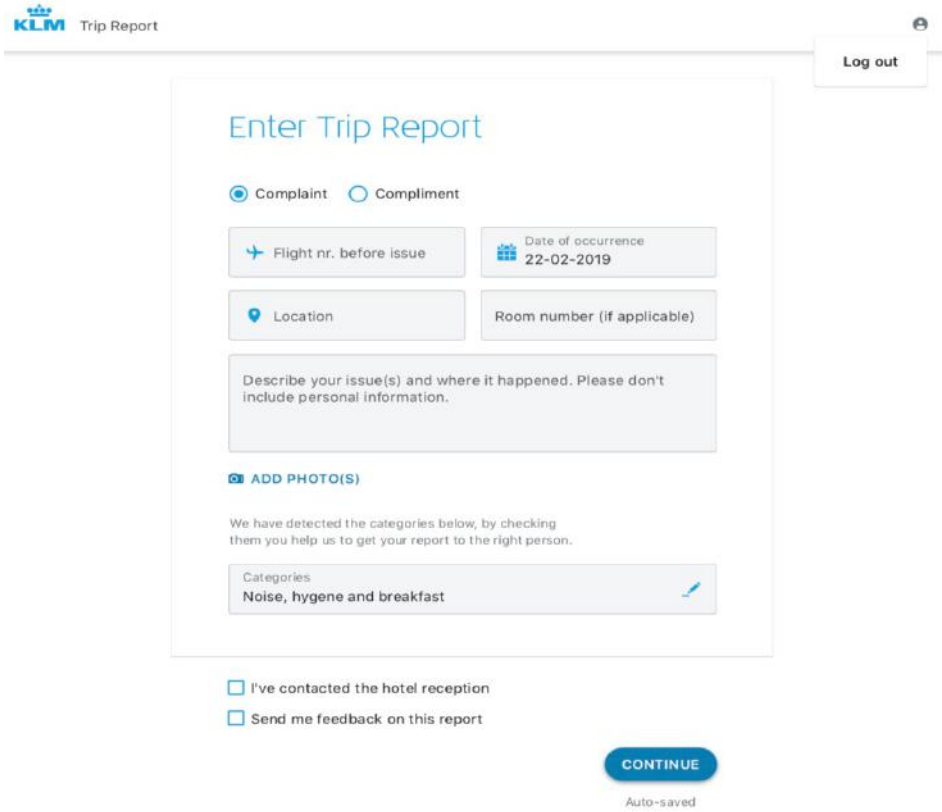
Devlin, Jacob, et al. "Bert: Pre-training of deep bidirectional transformers for language understanding." *arXiv preprint arXiv:1810.04805* (2018).

TripReport classification: results

- Experiments are done on hotel related cases
  - Started with 356 labels and cut-it down to 34
  - ~15k reports for training models and hyperparameter search
  - 2k reports annotated for the final evaluation

Model	F1 micro	F1 macro
SVM	0.75	0.62
Hierarchical model	0.74	0.63
Fine-tuned BERT	0.76	0.64
SVM with manual rules	**0.83**	**0.72**

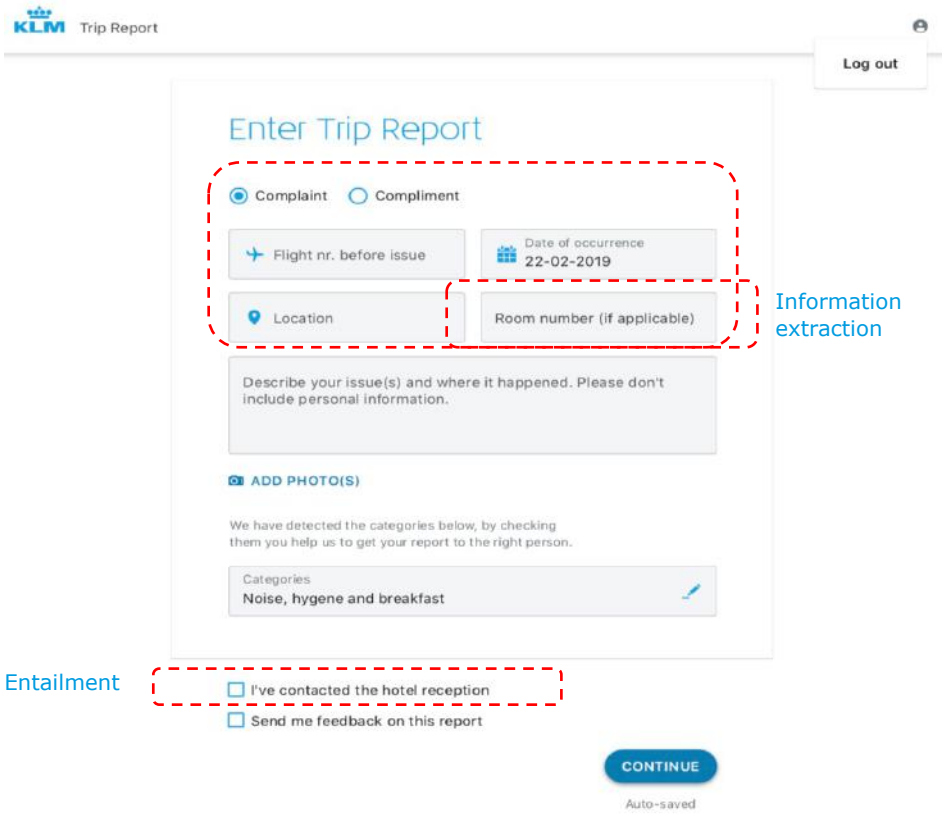
Re-designed solution



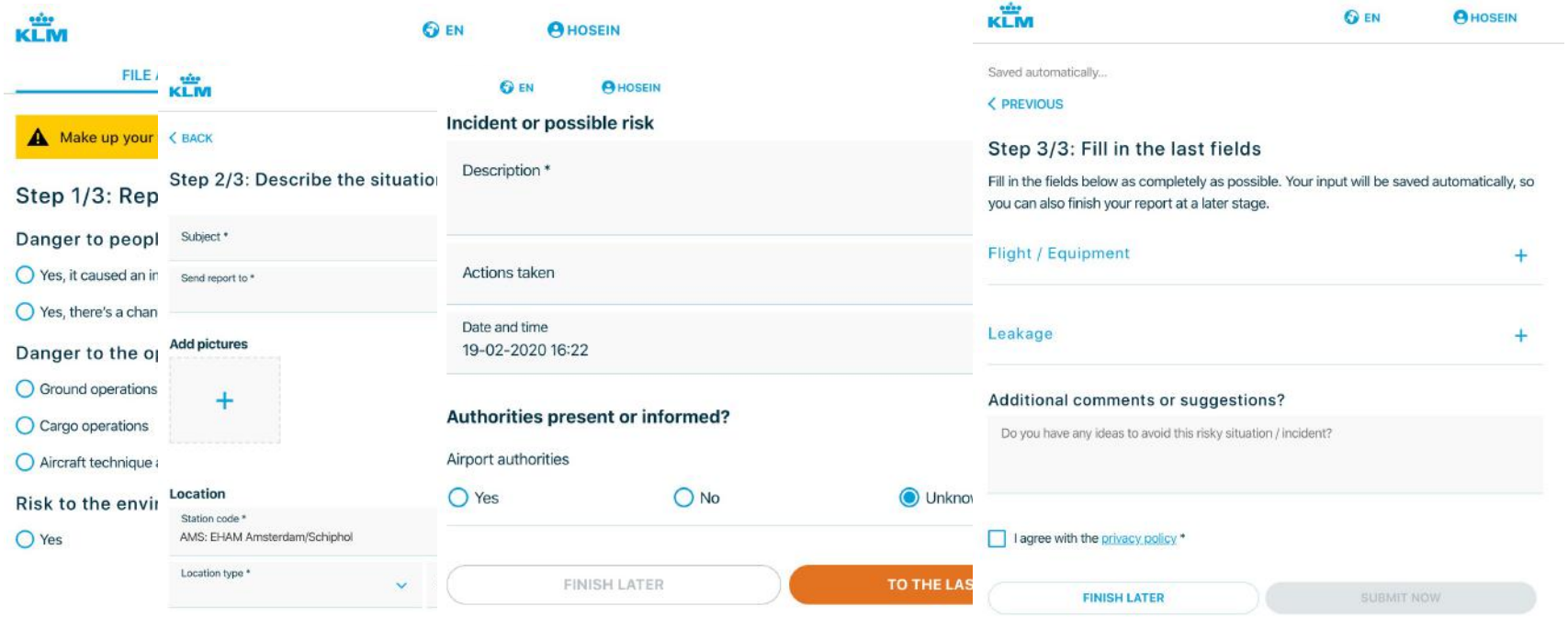
Test with users

- Crew satisfaction with POC: 8.3 / 10
- Faster: 4.2 / 5, easier 4.5 / 5
- Classifier results:
  - Accuracy:0.87
  - Accuracy with user interaction: 0.83
- Identified improvements: auto-fill information

Auto-filling information

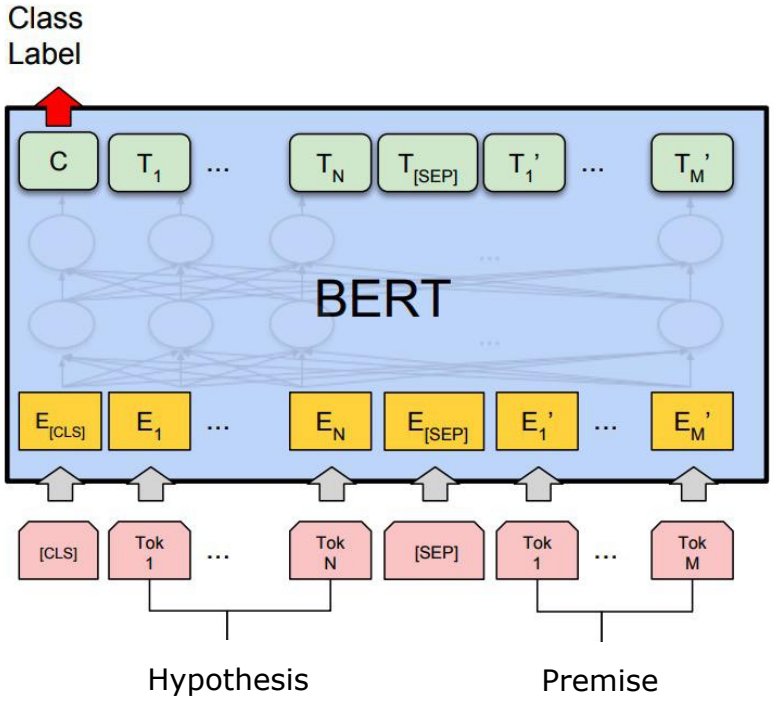


How complicated can a report be?



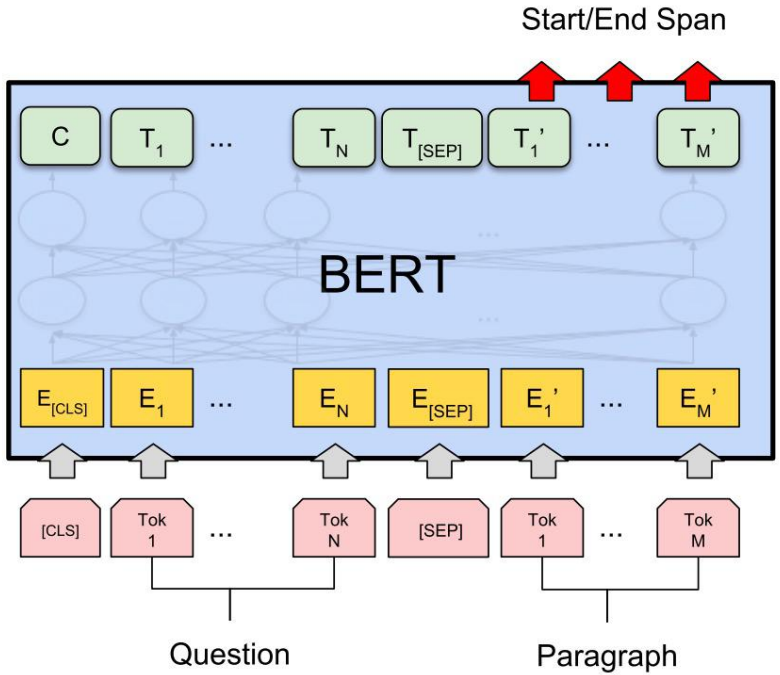
Textual entailment

- A fine-tuned BERT model for NLI
  - Trained on XNLI dataset (~112.5k samples)
  - Fine-tuned with 2k annotated samples and evaluated on 1k samples
- Premise: input report
- Hypothesis: “reception is contacted”
- Predict if hypothesis is correct or not (entailment, neutral, contradiction)
  - If ‘neutral’ then ask the user to provide an answer



Fill-in boxes

- A fine-tuned BERT model for question answering
  - Trained on SQuAD v1.1 dataset (100k question-answer pairs)
  - Fine-tuned with 2k annotated pairs and evaluated on 1k pairs
- Paragraph: input report
- Question: “what is the room number”



Results

- Both models can answer questions with a high accuracy
  - There is still a lot of domain specific information
- Checkbox questions are easy to answer

Task	F1 micro	F1 macro
Checkboxes (BERT)	0.93	0.87
Checkboxes (SVM)	0.82	0.75
	F1	**Exact Match**
Fill-in boxes (BERT)	0.83	0.81
Fill-in boxes (rule-based)	0.61	0.53

Learning

- To really help users with AI, it is important to involve them in the process as early as possible
  - Domain knowledge plays an important role in designing real-world AI models

- Intuitive UX and application design can help users trust the underlying AI model