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| ITU Logo | INTERNATIONAL TELECOMMUNICATION UNION**TELECOMMUNICATIONSTANDARDIZATION SECTOR**STUDY PERIOD 2017-2020 | FG-AI4H-K-032 |
| **ITU-T Focus Group on AI for Health** |
| **Original: English** |
| **WG(s):** | Plenary | E-meeting, 27-29 January 2021 |
| **DOCUMENT** |
| **Source:** | Goethe Business School, Goethe University Frankfurt |
| **Title:** | Trust between AI and Human Being in the Pharmaceutical Business Context of Oncology and AI-supported Customer Relationship Management Solutions[[1]](#footnote-1) |
| **Purpose:** | Discussion |
| **Contact:** | Manuel BierwirthMerck KGaA DarmstadtGermany | Tel: +496151-728247Mob: +49151-14548247Email: manuel.bierwirth@merckgroup.com |

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| **Abstract:** | This document presents selected main factors impacting trust between Human Being and Artificial Intelligence. Foundations of this research are trust building, trust maintenance and relevant factors in human relationships. Subsequently, the new relationship and relevant factors for trust building between human and AI are pointed out. In the master thesis the role of anthropomorphism and appearance of AI is explained and how AI on the one side avoids and on the other side induces bias. In the work two projects from the pharmaceutical industry are referenced, where AI provides suggestions on next best actions to the human users based on a machine learning prioritization approach. As findings, relevant trust factors and their transferability from human-human to human-AI relationships are specified, based on scientific prevalence and interviews which have been conducted with healthcare sales representatives (sales reps) and sales managers for a better understanding of the future user needs. Key findings are that performance factors of AI have the highest impact on trust. In conclusion, factors like a shared mental model to allow a common understanding of the AI capabilities, data accuracy, user experience specific trainings and a clear communication of the purpose are some of the most important factors for sales reps working with AI. The master thesis closes with a developed implementation proposal to establish trust in AI-based applications for future projects. |

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# Introduction

AI has become a significant player in the pharmaceutical industry. If this development continues, AI potentially becomes a new teammate for human colleagues. Trust is the basis of good teamwork, but an essential hurdle is the formation and maintenance of trust between human being and AI. Without trust there will be hardly any adoption and AI projects might struggle. Therefore, the present research paper investigates on trust between human beings and AI, applied to the pharmaceutical business scenario of field force and healthcare professionals (HCP’s), e.g. oncologists.

# Research Question and Methods

Research question:

“Which factors influence trust and how can trust between AI and human beings (here sales reps) be established and/or improved? “.

Research methods:

Literature review: A deductive research approach was applied, which focuses on the formulation of a hypothesis based on existing theory and testing of the hypothesis during the research process.

Qualitative interviews: To understand from experts if there are other factors outside the literature perspective which are relevant in human-AI and human-machine collaboration, a further method of qualitative interviews was added.

# Trust Factors between Human-Human, a Reference Model

Trust is the basis of a meaningful collaboration in both private and professional relationships. With only one incident of behaviour other than one that someone considers trustworthy, the good relationship with another person can be broken, “trust takes a long time to build, yet you can blow it in a matter of minutes” (Blanchard et al. 2013, preface). Trust results from behavior. Behavior that either enhance or diminish trust. In the “ABCD Trust Model” of Blanchard, behavior to build and maintain trust fall into four main groups: “Able” (show competence), “Believable” (act with integrity), “Connected” (care about others) and “Dependable” (maintain credibility) (Blanchard et al. 2013, pp. 11–36).

**Figure 1: Trust illustrated: The manager securing the
employee**. Adapted illustration based on (Schmiedel 2017, p.3)

ABCD Trust Model categories (Blanchard et al. 2013).

*In private and professional relationships*

* Able (competence and skills)
* Believable (Act with integrity)
* Connected (Care about others)
* Dependable (Demonstrate what you say)

In professional relationships (Schmiedel 2017),
example Manager and employee,
Trust building and maintenance through…

* The development of employees
… is essential
* Also, a culture where an employee
is permitted to make mistakes
is fruitful for trust building

# Limitations and Trust participants: Human, AI, AI-Designer and the Oncologist?

1. Situational decision making: The machine is not capable to bring in human understanding and thoughts like situational decisions
2. Release of Oxytocin: A hormone release like the creation of oxytocin can only happen on the human side, but not on the machine side of the relationship. But in a stressful situation still a trustful situation and affection from the human to the machine can happen, if. e.g. the machine remains reliable and collaborates while human colleagues are not available. Oxytocin releases from human in a comfortable and trustful atmosphere

1. Trust parties / participants, from 2 (human-human) to 3 (Tschopp and Rueff’s model of Trust between human and AI) to 4 participants (adding and including the HCP, the Oncologist)



**Figure 2: Enhanced model – Trust between human-AI with four participants: Sales rep, AI-System, AI-Designer, HCP.** Adapted illustration based on (Tschopp and Ruef 2020)

# Trust Factors and Transferability from Human-Human to Human-AI Relationships (Selection)

This chapter discusses which of the trust factors relevant in human-human relationships can be compared with and transferred to human-AI/machine relationships, the limitations and potential new opportunities. The ratings (High/Medium/Low) for the scientific relevance result from the prevalence of the factors found in literature. Ratings for transferability (with ratings High/Difficult/Not transferable) are based on either references found in literature or on own opinion of the thesis author, see table 1.

**Table 1: Trust factor analysis (Selection), transferability of trust factors from human-human to human-AI relationships.** Own illustration based on (Hancock et al. 2011), (Freedy et al. 2007), (Aerts and Mitchell 2020), (Blanchard et al. 2013)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Trust factor** | **Factor details** | **Relevance and transfer potential to a human-machine/AI relationship** | **Scientific relevance** | **Transfer-ability** |
| **The ABCD trust model** |
| Ability | Demonstrate competence and skills, shows that you are able (Blanchard et al. 2013)  | “Ability” is a relevant trust factor (Blanchard et al. 2013) and can be transferred to human-AI trust factors. We can compare “Ability” with the following machine performance factors: “Level of automation”, “Failure rates”, “Behavior”(Hancock et al. 2011). The performance factors represent the most impacting trust factors of a human-AI partnership (Hancock et al. 2011) |  |  |
| Believability  | Act with integrity, show that you are believable (Blanchard et al. 2013) | To act believable and with integrity is relevant and can be transferred. The “believability” factor can be compared to the performance factors “Reliability” and “Predictability” (Hancock et al. 2011) |  |  |
| Connected-ness | Listen to someone, show interest and share about yourself (Blanchard et al. 2013) | To be connected to someone else is an important trust factor in human-human relationships, but it is difficult to transfer to a human-machine relationship. It can be adapted by collecting frequent feedback from human users on meaningfulness of the results or data correctness and by incorporating the feedback into the machines algorithm and code |  | Difficult |
| Depend-ability | Demonstrate that you do what you say, be organized and accountable (Blanchard et al. 2013) | A dependability to the other partner is relevant and can be transferred to a human-machine relationship. This trust factor can be compared to the performance factors “Reliability” and “Dependability” (Hancock et al. 2011) |  |  |
| **Further human-related factors** |
| Self-confidence | A person’s confidence or awareness to him or herself and self-confidence to execute a task | Relevant (Hancock et al. 2011), as a human needs to be self-confident to work and exchange information with a machine teammate. On the other side a machine will have its difficulties to develop self-confidence due to the missing consciousness of the machine. In human-robot teaming self-confidence can play another role, “where the human uses the robot for tasks or subtasks the robot performs better or safer while reserving those aspects of the task the robot performs poorly to the human operator” (Ososky et al. 2013)  |  | Difficult |
| **Environmental factors (team & tasking)** |
| Culture | The culture characteristics embedded into the AI algorithm by the algorithm designers | Culture plays a role in trust building, a machine or algorithm could for example interact very politely, when the culture or country of the user audience expects a very polite wording. AI incorporates culture (Aerts and Mitchell 2020, p. 34) |  |  |
| Shared Mental Models | “A shared mental Model (SMM) is a representation for humans to understand the world around them” (Ososky et al. 2013) | A shared mental model can help to not overestimate machines capabilities, “as an incomplete mental model may lead to an overestimation of robots abilities” (Ososky et al. 2013). A model of a robot teammate includes the knowledge about robot capabilities, limitations and personality (Ososky et al. 2013). Mental models can support human team members to have appropriate trust in robotic systems and help with the decision to involve or to not use the robotic teammate (Ososky et al. 2013) |  |  |
| **Further factors** |
| Anthropo-morphism | Machines appearance in animal form and human perception of an animal like companion | Relevant (Hancock et al. 2011), the physical appearance of a robot in animal form and accompanying the human can help the human in trust building. The factor is not directly relevant for the sales rep use case, but is related to the general trust factor of AI representation |  |  |
| Trust over time | Trust formation over time | Relevant (Freedy et al. 2007): Trust formation can happen over time, the relationship can become stable and increase if the collaboration works over time |  |  |
| Low / High competence setup and over-trusting, under-trusting, proper trusting | The MITPAS simulation (“mixed initiative team performance assessment system”) and proper-trusting (Freedy et al. 2007) | Relevant (Freedy et al. 2007): low machine competence will lead to high manual corrections whereas medium and high machine competence will lead to not meaningful or low manual corrections (Freedy et al. 2007). If a low machine competence setup is given in the beginning, trust is increasing over time and several trials, e.g. because wrong results are even accepted and trusted as the human expects them to come, the human is aware that the machine will make mistakes (Freedy et al. 2007). For medium and high machine competence the level of trust remains relatively unchanged over several trial runs. Operators over-trusting the machine would override the machine only rarely, where under-trusting operators tend to do that too often, the most meaningful and economical approach is proper-trusting, to override the machine only a few times when potential loss or damage is low and to take over more control and override many times if the potential loss and risk is high (Freedy et al. 2007) |  |  |

# Ranking of the Human-AI Trust Factors in Three Groups (Selection)

The ranking is divided into three ranking groups (RG): “1. Very important”, “2. Important”, “3. Relevant but with lower impact”, see table 2.

**Table 2: Most important trust factors for sales reps working with AI (Selection).**Own summary based oninterview feedback and (Hacker et al. 2019), (Ososky et al. 2013),
(Lee and Moray 1994), (Siau and Wang 2018), (Phillips et al. 2012)

|  |  |  |  |
| --- | --- | --- | --- |
| **Factor** | **Source** | **What does it mean to the sales rep and implementation feasibility** | **RG** |
| Ability & performance | Literature (Hancock et al. 2011) & interviews  | Sales reps will gain trust if the algorithm works and the results presented by AI are useful  | 1 |
| Believability | Literature (Hancock et al. 2011) & interviews  | Sales reps will benefit from suggestions which are believable | 1 |
| Connectedness & feedback exchange | Literature (Blanchard et al. 2013) & interviews | Sales reps will gain trust if future processes and suggestions of AI will incorporate feedback, which will continuously be collected from sales reps | 1 |
| Dependability | Literature (Hancock et al. 2011) & interviews  | Sales reps will maintain trust whether the output from the AI-based system remains dependable over time | 1 |
| Self-confidence & perceived risk of using the machines versus the perceived benefit factor | Literature (Hancock et al. 2011) & (Ososky et al. 2013) | Sales reps can check their self-confidence on specific tasks, as “in human-robot team tasks, there may be sub-tasks for which robot performance is poor, but human performance is worse, an assessment of human and robot performance is necessary, given situational factors, to allocate tasks to the best team member” (Lee and Moray 1994) | 1 |
| Shared mental models  | Literature (Ososky et al. 2013) | To understand machines and AI abilities and to avoid overestimation and underestimation, a shared mental model needs to be introduced which allows the sales rep to understand the AI capabilities. The mental model can support the sales rep and the sales manager to have appropriate trust in AI-based systems and help with the decision to involve or to not use the system for specific tasks | 1 |
| Technical skill and habit constraints | Interviews  | In the community of HCPs but also in field of sales reps we can find individuals which are not technology experienced or do not use technology platforms, tools or smartphone apps except for email communications. There will be sales reps more open to AI-based recommendation systems, but some sales reps will have issues as they traditionally work with their own notes and handwritten data. Only if all sales reps jointly invest time and show willingness to AI-based systems supporting their business, the AI system can learn and improve from feedback, data entries and data corrections | 1 |
| Purpose (control tool?) | Interviews  | The AI-based tool and purpose needs to be clearly explained to the target audience, the sales reps as part of the field force. Sales reps need to be educated in functionality and planned usage of the system provided results and reports to ensure sales reps trust into the process and to ensure sales reps cooperation. Sales reps need to understand that the tools will be introduced to support and not to replace them | 1 |
| Face to face remains vital | Interviews  | Automation cannot replace face-to-face contacts by 100 %, acceptance and trust will be increased if the tools still allow and suggest physical collaboration of the sales rep with the HCP. It can be a mix of face-to-face contacts and other digital channels | 1 |
| Training | Interviews  | Training of the user audience, sales reps and sales managers, is of utmost importance to make sure that all potential users understand the capabilities of the AI-based systems and to ensure that the systems are used in the right way and results are interpreted correctly | 1 |
| Culture | Literature (Aerts and Mitchell 2020) | Sales reps will build up trust in the AI, if their country specific culture is incorporated in the logic of the algorithm or in the presentation and wording  | 2 |
| Low / High competence setup and over-trusting, under-trusting, proper trusting & trust over time | Literature (Freedy et al. 2007) | Increasing trust of the sales rep by setting up a low machine competence in the beginning, will lead to increased trust over time and several trials, e.g. because wrong results are even accepted and trusted as the human expects them to happen. Training cases for the sales reps with machine intermediate competence should be preferred to cases with low or high competence to avoid the creation of bias of either perfectionism or high error-proneness | 2 |
| Reputation & the role of the technology provider  | Literature (Siau and Wang 2018) | A technology provided by an institution with a high reputation to gain trust from others will have it easier to be accepted and trusted than if it comes from an institution with a low reputation. On the other side new companies can also build a reputation, especially in technology, newcomers are perceived as innovators | 2 |
| Reality check Plan vs Current | Interviews  | Sales reps and their customers agree on certain treatments of patients, if the doctors are convinced of a medical drug. This can be an informal agreement but still the sales rep counts with this business. Market data analyses and the maintenance of Patient Support Programs (PSP) will show later, whether a treatment did really happen and if patients did stay on a treatment. The sales rep will gain trust in the system, if the correct market data and the actions taken by the doctors are reflected in the AI-based solutions. It is a business promise versus reality check | 2 |
| Representation and Anthro-pomorphism | Literature (Phillips et al. 2012) & (Hancock et al. 2011) | The physical representation of autonomous systems and machines in confidence inspiring animal pet like form can increase trust (Phillips et al. 2012). In the sales rep and oncologist use case, the appearance of the AI is restricted to an appealing and modern iPad device and anthropomorphism is not relevant | 3 |

# Implementation Proposal “to Ensure Trust of Human Users” in AI-supported Projects (Selection)

Human users – e.g. sales reps and oncologists – did express their interest and willingness to collaborate with AI-based systems providing suggestions within their professional setup. Trust into the systems, their purpose and underlying data are relevant for the adoption of the systems. The following three-step approach should be applied by a project team and responsible managers in an organization to establish trust of users into AI-based solutions and other future projects, where humans form a cooperation with AI-based systems and solutions:

## First step: Pre-requisites and preparation of the organization

1. Factor “Culture & country” specifics
	1. Check on the country specifics on culture, processes and language where the solution will be deployed. Specific processes might be relevant for the country. Such as HCPs cannot be called on specific dates in the year or that individual HCPs are not willing to read digitally prepared material sent by the sales rep. HCPs might have a different daily routine in different countries
	2. A specific wording can be relevant in the collaboration between the sales reps and the AI technology (e.g. wording suggestions and feedback options). In one culture the wording should be very formal, in another a very polite wording will be required to allow a good collaboration between the sales rep and AI
	3. The project team and the AI-designer can be from a completely different culture and country to targeted audience & users. The culture and country specifics of the target audience need to be listed and considered by the project team and designer of the AI-algorithms and to be reflected in the technical solution
2. Factor “Shared mental models”
	1. Create a shared mental model (SMM) which includes the capabilities and limitations of the AI-based technical solution, see table 10 below: A shared mental Model proposal developed for the purpose of sales reps understanding of the AI/ML tool capabilities within the “Veeva iConnect suggestions” application
	2. The SMM will allow the sales rep and sales manager to apply the appropriate level of trust and to decide if specific tasks will be conducted with or without the help of the AI-based solution
	3. Shared mental model proposal for the collaboration of sales reps with AI-based tools: A SMM should contain four knowledge content models, the equipment model, the task model, the team interaction model and the team model, see table 3 applied to the collaboration case of human sales reps with non-human AI-based tools, based on (Cannon-Bowers et al. 1993) and (Ososky et al. 2013)

**Table 3: Shared mental model proposal for sales reps and AI-based tools**: Own compilation based on (Cannon-Bowers et al. 1993) and (Ososky et al. 2013)

|  |  |
| --- | --- |
| **Knowledge content models** | **Knowledge areas** |
| The equipment model | **Operations/functions**: Oncology market & business rules catalogue; Sales rep & oncologists’ feedback and interaction options catalogue **Limitations**: Tool & data restrictions; Data and parameters scoping; Market scoping; HCP scoping; Summary of AI and ML actionable data |
| The task model | **Procedures**: Prioritization rules; How feedback is used for future prioritization and suggestion generation; Low/High competency task examples; Potential errors**Strategies**: Guidance in case of issues; Planned additions; Contingencies for completing the work |
| The team interaction model | **Team member roles**: Role-definitions of the human user and the AI-based tool; Task/deliverable-responsibility **Communication patterns**: Communication plan and schedules; Consequences on non-usage and suggestion rejections **Dependencies**: Integration with daily processes and work implications; Impact on sales rep performance |
| The team model | **Knowledge about other teammates**: Knowledge, skills and abilities catalogue of the complete team including human and non-human teammates (AI-based tools), relevant for the collaboration |

1. Factor “Low / High competence setup and over-trusting, under-trusting, proper trusting & Trust over time”
	1. Make sure to include examples into the “shared mental model” which explain tasks with low complexity and low competence needs from the AI-based system, but very high probability that they work out. Explain the potential mistakes which can occur from the machine
	2. If positive results and expected mistakes will occur over time, trust will be fostered by the user audience
2. Factor “Technical skill & habit constraints”
	1. Check on the organization and people readiness to have access to and work with AI-based solutions. If the tools will be presented via tablets or smartphones, the user audience need to be equipped with such devices and they need to be trained to use the tools appropriately
	2. Check on the target audience habits. Are the users willing to work with digital supported market analyses and recommendations or will they continue to prefer to work with their own data and notes

## Second step: Training of and communication to the target audience

1. Factor “Ability”: Explain and train the ability and the limitations of the AI-based solutions to the target audience by communication of the “shared mental model”. A periodic user retraining on the AI-supported tool and capabilities is recommended
2. Factor “Purpose (control tool?)”
	1. Beside the capabilities, a clear communication of the purpose of the AI-based solution is needed. Why is the organization introducing such tools? What will be done with the provided results and created data? Which benefits but also which impact can employees expect from the collaboration with AI-based solutions?
	2. The clear communication of the purpose is necessary to have sales reps trusting and investing their time in AI-based solutions and to avoid negative impact on the work atmosphere, if users perceive them as new employees performance control tools or potential replacements of human workforce by digital processes
3. Factor “Self-confidence & perceived risk of using AI versus the perceived benefit factor”
	1. During user training make sure that the audience develop an understanding about which tasks can be performed by the AI or machine either better than by the human or less badly. The human user could have a low self-confidence over a specific task, where the user would trust in the AI-based system to perform the task with a higher reliability or quality
	2. Check on recurring and repeating activities where the machine reliably repeats a process or task, whereas a human could start to produce mistakes running the same tasks for many times and potentially becoming inattentive

## Third step: Process execution, monitoring of the progress and success

1. Factor “Representation”
	1. Make sure that the tool and AI-based system is reachable and easy to use for the target audience, the appearance should be appealing and not off-putting
	2. The AI-based suggestion tool in the referenced project examples will be presented on an Apple iPad device. This is an appealing and modern form of presentation and will allow the sales reps to receive information and provide input while being in the field to visit customers
2. Factor “Reality check Plan vs Current”
	1. Make sure that sales reps and users are using the systems and deal with the suggestions out of AI-based systems. Ensure that they monitor their own business and find out if e.g. a treatment aligned with HCPs months ago really resulted into planned prescriptions to patients
	2. Additional usage of Patient Support Program (PSP) tools can be helpful to check if patients are in and stay on specific treatments
3. The human decides and performs the final check
	1. Make sure that sales reps and users understand that working and collaborating with AI-based tools requires the human always to perform a final human check on whether the system really did come up with meaningful suggestions. The evaluation of the sales rep about the quality of the proposal, can be very helpful
	2. Human intuition is important here, the human retains the final decision to accept the suggestion and on the next action
4. Measurement and monitoring of the implementation
	1. User adoption and usage of the AI-based tool can be checked via system log files from system administration teams and results can be provided to sales teams. A frequent retraining of the AI-supported tool and capabilities is recommended
	2. Field force effectiveness checks can be done by the sales teams, e.g. if sales are going up or down after the integration of AI-based solutions in a specific market versus a market and a user group where the application has not been introduced

# Conclusion

This thesis did confirm the hypothesis that there are factors influencing trust in human-human and human-AI/human-machine relationships and answered the research questions “Which factors influence trust and how can trust between AI and human beings (here sales reps) be established and/or improved?”. Although the machine performance and attributes have the highest impact on trust, as confirmed by scientific research, the human related factors and capabilities also play an important role. Trust develops over time by the human. The human might bypass a process step by affective methods. Different levels of skills and experience working with AI and digital tools, and in the interpretation of AI-based results, are available on the human side. From the huge variety of factors influencing trust of humans in AI and in machines, it seems that the following factors are the minimum to be considered in the successful roll-out of AI-based Customer Relationship Management (CRM) tools for sales reps in pharma companies or similar project approaches:

1. Performance of the algorithms with meaningful results, creating useful suggestions
2. Country and culture specifics on working routines and wording
3. Shared mental models: So that each stakeholder and involved person understands the AI-based CRM system capabilities and limitations with clear and easy examples
4. Purpose and intention of the AI-based solution needs to be clearly communicated to avoid wrong expectations and to avoid fear and rumours
5. Training of the prospective users and having training kits available for different levels of expertise with AI and digital tools in general, is crucial

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1. Original title and context: Trust between AI and Human Being in the Pharmaceutical Business Context of Field Force and AI-supported Customer Relationship Management (CRM) Solutions; The trust factors in the ranking table and in the implementation proposal are a selection from the original thesis, author: Manuel Bierwirth; Figures are used for educational purposes [↑](#footnote-ref-1)