Personalized Manufacturing

Designing Manufacturing Systems around Human Emotion to Give the Most and Get the Most from our People

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2nd Annual blue sky competition
What’s Wrong?

• The Industrial Internet of Things (IIoT, Industry 4.0) is connecting machines - robots - software - supply chain, automatically generating and moving information and adapting processes to changing conditions

• Workers are anxious, stressed, apathetic, disengaged, even derisive or offended, unsure of their role in the New Manufacturing
Current Steps

- Human Factors
- Collaborative Robotics
- Augmented and Virtual Reality
- Human-Systems Integration
- Persuasive technology (e.g., Gamification)
- Facial recognition / voice processing
- Kansei (Affective) Engineering

Projected Assistance, Fraunhofer IPA

MIRO, Consequential Robotics

Bosch Active Assist

Sophia, Hanson Robotics

Affectiva
(el Kaliouby, MIT)
What’s missing: Exciting people about their jobs

“We can say without exaggeration that the present national ambition of the United States is unemployment. People live for quitting time, for weekends, for vacations, and for retirement; moreover, this ambition seems to be classless, as true in the executive suites as on the assembly lines. One works not because the work is necessary, valuable, useful to a desirable end, or because one loves to do it, but only to be able to quit - a condition that a saner time would regard as infernal, a condemnation.”

~ WENDELL BERRY

How could we deal with this??
Example: Define “Manufacturing Emotion”

- Keeping workers excited and motivated over the long term; stimulating pleasure centers for engagement.
- Rules and reward systems to stimulate instinctual and intermittent behavior reinforcements.
• Emotional control of robots and machines
  • Affective engineering applied to manufacturing
  → Companionship! Trust!

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<th>Need: Improve Safety, Quality of Life, + Productivity of Work 4.0</th>
<th>Socio-Tech Needs</th>
<th>Neurocognitive &amp; Social-Behavioral Capabilities</th>
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- **Work 4.0 – Empowering Work through Augmented Intelligence**
  - Enhancing Worker’s Perception, Cognition + Actions in Collaborative Robotics Environments
Emotional Bonding (eliciting emotions in humans, and programming emotion to machines in order to create an empathetic feeling relationship.)
Extract human information, apply it to control, state identification of human behaviors... bonding AI capability and fusing it with human ability.
Example: Designing using Psychosocial Models

- People need to experience and perceive environments differently
  - Deliver information in customized formats, personalization of interfaces & communication
  - Users have control!

Stage Theory [Erikson 1950]

Demand/control [Karosek 1979]

Stress-Response (Maximal Adaptability Model)

Job Stress model [NIOSH 1992]
If the system understood in real time how a human would respond, it could adapt presentation of work and parts, and modes of communicating information.
Example: Behavior Prediction in Teaming

- Sensing and models to gage human intent in teams
- Technology for shared experiences, support, reinforcement

Caregiver Peer Support model [Heisler 2006]
Shared Experience (multiple modes of communicating perceptions, feelings, even predictions to allow for empathy in the process).
Example: Human Adaptive Control

• Sensing and models to gage human condition
  • Fusion of physical and psychological measures
• Adaption of machine control to that human, at that moment
What is the Science?

• What are the critical metrics of a human, important to manufacturing system integration, and how do we measure?
• How can (soft, subjective, uncertain) human data be well-fused with (hard, objective, deterministic) machine data?
• What information models apply?
• How could one use the tools of digital manufacturing such as Big Data Analysis and Deep Learning on human data streams, in order to understand the patterns of people’s performance and feeling, integrate this data to control, and interpret the effect on manufacturing output and overall quality of life?
What is the Science (and how will it be used)?

How will knowledge be integrated?

What artifacts will emerge?

What basic understanding is generated?
Who is needed to really address this?

• Convergent effort will require researchers (in addition to engineers):
  • psychologists,
  • sociologists,
  • biologists,
  • pedagogy researchers,
  • computer scientists,
  • logicians,
  • systems thinkers,
  • experts in privacy, security and philosophy
• Plus users:
  • Machine & robot builders, industrial implementers…
An Internet-of-People-and-Systems, understanding, cooperating, and leveraging machines and one another

Humans and machines are indistinguishable as data generators and information consumers, but take advantage of
  - Human creativity, cognition, adaptability, interpretation
  - Machine/cloud precision, capability and computational prowess

People are excited about their job because they are in control, feeling loved, being positively reinforced, and the system is working for them instead of the other way around.

Thank you (from the concept team, doing the things they think about when they should be working)!