U-SIT And Think News Letter - 11

Updates and Commentary

Unified **S**tructured **I**nventive **T**hinking is a problem-solving methodology for creating unconventional perspectives of a problem, and discovering innovative solution concepts, when conventional methodology has waned.

Dear Readers:

- Mini-Lecture_10 completed the analysis phase, which introduces the solution phase through the QC-graph tools. In this lecture we consider uniqueness as a problem-solving technique.
- The next newsletter will be devoted to discussion of feedback issues that probably touch on common questions.

1. USIT – How to Invent: the USIT textbook.

2. USIT – an Overview

3. Mini USIT Lecture – 11

UNIQUENESS – A Problem-solving Technique

Continuation of the publisher's problem – "Ink on newsprint is messy. Fix it!"

Recap: Mini-Lecture_10 completed the construction of QC-graphs that characterize trends in attributes supporting an unwanted effect. We now turn to USIT solution techniques. Recall that two solution techniques derive from the QC graphs.

ML_11: **Uniqueness as a solution technique**

Uniqueness suggests examining a problem to determine what sets it apart from otherwise similar problem situations. Until you have gained the experience of solving a few problems using uniqueness, it may pose a bit of a hurdle – a common occurrence in my teaching experience. My recommendation is to start with a one-dimensional spatial plot and a one-dimensional temporal plot of functions and effects in the problem. Use these to identify where and when things happen.

Once uniqueness has been characterized as functions and effects, by boxes located in space and time, we look for new arrangements of the boxes and consider solution concepts they may suggest. We can multiply boxes, divide boxes and separate the parts, mix parts, change positions of boxes using separation, superposition, and reversal.

Our publisher's problem emerges during offset printing of newspaper. The printing process can be simplified as a sequence of steps like the following[1]:

- An image on a rotating metal plate is first coated with water that adheres where there is no image and is then coated with ink that adheres where there is an image;
- The rotating plate then transfers the ink image to another roller (called a "blanket") that rotates in contact with high speed paper and transfers the ink image to the paper;

- The paper continues on to other stages for cutting, folding, stacking, and storing.
- The paper is next transferred to the user.
- The user receives the paper with ink still capable of being smeared unless it has dried.

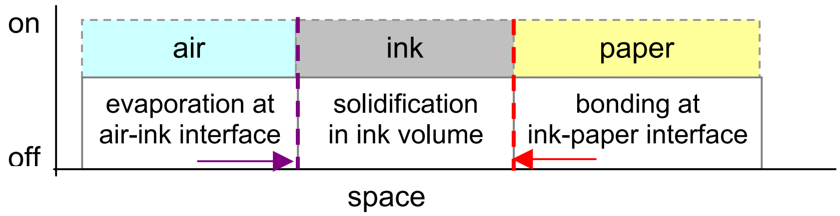

Figure 1. Two interfaces, air-to-ink (broken purple line) and ink-to-paper (broken red line), bound a volume of ink, where ink "drying" occurs by evaporation, solidifying, and bonding. "Solidification" refers to all processes occurring in the bulk of the ink that are relevant to "drying". These three processes occur at different locations.

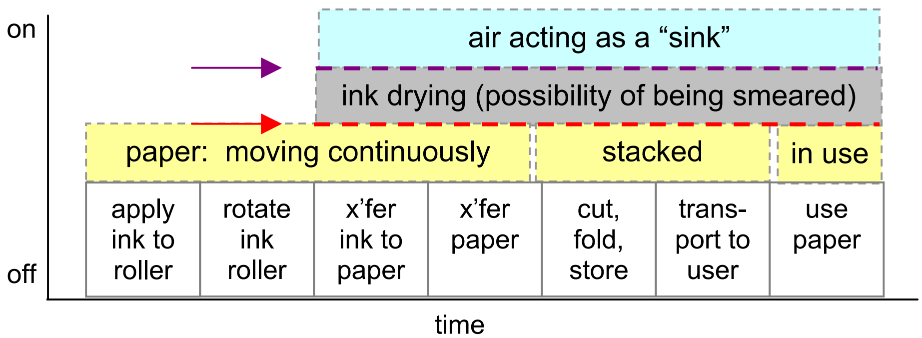

Figure 2. Temporal plot of functions and effects: Up to the point of being cut, paper is in continuous transfer (x'fer) through rollers. Air acting as a "sink" refers to the collection of evaporating molecules in the air that contacts ink.

Comparison of Figs. (1) and (2) shows a uniqueness of this system: namely, that the three processes, evaporation, solidification, and bonding, occur at different places but at the same time. To eliminate complaints of ink smearing we need to bring ink to a dry state by the time it is first handled. The first five process steps, indicated by boxes in the bottom row of Fig. (2), are automated steps done by equipment (without human contact). The last two, transporting to user and using paper are opportunities for unwanted smearing (until it has dried adequately).

Division of the "x'fer ink to paper" box in Fig. (2) brings to mind ink divided into jets and jets divided into droplets and droplets divided or shaped for effective drying (dividing to an extreme): **[12]** use ink jets that eject small droplets at high velocity. The impact of droplet with paper will instantly spread out the droplet into a thin broad region giving the resulting ink splats large surface-to-volume ratios for accelerated evaporation. Use **[13]** micro-jets of ink heated to near their boiling point to increase their vapor pressure and evaporation rate. Evaporation of the liquid phase of a splat will quickly cool the splat through energy lost as heat of vaporization. Hot droplets bring to mind **[14]** to use melted wax as the liquid phase of ink instead of water. This allows solidification of the wax without the need of evaporating any component of ink. If using micro-droplets of wax, the droplet temperature could be in excess of the ignition temperature of paper with no danger of burning the paper. Most of the excess energy will be lost quickly in conductive heat transfer from the thin splat through its exposed surface into the surrounding air. With the "transfer of ink to paper-box" divided into sequential high-speed drops of hot water-base ink, the space between sequential drops should be evacuated of evaporating molecules as quickly as possible. **[15]** Maintain a less than atmospheric pressure of air between ink jets and paper. This can be done with jet nozzles close to paper and each nozzle encircled by an (open-ended) annular vacuum chamber – a nozzle inside of an evacuation tube. In the case of a super-heated wax-based ink **[16]** the ambient air could be pressurized above atmospheric pressure to increase its density, and cooled, for improved heat transfer. This can be done **[17]** with pressurized air sprayed through an annular ring around the jet nozzle onto the ink splats as they are formed. **[18]** Water-based ink, in a squeegee-type of ink application, could be replaced with super-heated wax-based ink.

Perhaps the most obvious solution concept is evident in the "x'fer paper" box (Fig. 2) following the application of ink. The length in time of this box **[19]** can be increased to whatever length is necessary to produce adequate ink drying. This can be done by spatially lengthening the free run of paper before cutting and folding. A back-and-forth staircase-type path for the paper could be used to minimize the effective footprint of this extended drying section.

Although we teach never to interrupt the creative process of generating solution concepts with attempts to filter the concepts, it seems almost necessary, in this lecture format (invisible readers with whom I can't converse), to comment on anticipated concerns. I see two possible concerns:

1. "Sprayed-droplet technology could never keep up with the high-speed paper transfer technology of offset printing!" May it could, and maybe it couldn't. I consider this an engineering scale-up issue to be addressed as another problem – a process guaranteed to produce more ideas. (It should be no surprise that solution concepts create problems.)
2. "Nozzle technology is not within the closed world of the given problem!" That is true, it is not. Remember that we are using a structured methodology to jog the creative capabilities of our unstructured minds. Ideas will lie within and without the closed world.

Exercise:
For your own amusement and amazement, try applying the other techniques under uniqueness (multiplication, separation, mixing, superposition, and reversal) to the rectangles shown in Figs. (1) and (2) to see if the method sparks new ideas in your mind.

([1]) The application of ink following the application of water to the metal plate (see first bulleted item in the above list) works because the plate is sensitized to form weak bonds preferentially with these two types of molecules. Some areas of the plate are hydrophilic while others are hydrophobic. This implies that ink is not in the form of a water-based colloidal suspension, as assumed in earlier discussions. Since water is a polar molecule such distinction could be made easily by making ink an oil-based (hydrophobic) colloidal suspension, since oils are non-polar.
I recently came to this understanding of the offset-printing process after visiting www.howstuffworks.com to see how offset printing is done. As usual, the more I get into analyzing a problem the more I learn about it. I don't intend to go back and correct any earlier comments in view of this new information. I will, however, try to use this new information in future comments. (Some previous references to water may be replaceable with "liquid".)

6. Feedback

I apologize for the two-month hiatus in newsletter publication. It was unavoidable. I'm gratified to receive confirmation of your continued interest. Some chronological excerpts follow:

William: "I'm interested".

Matt: "Definitely interested. Glad to hear you're feeling better!"

Carlos: "Of course we are!"

John: "I'm interested in your newsletter, but don't send the virus (internet or S. African)."

Marty: "Yes of course I am still interested in the USIT Newsletter and Mini Lectures. I have missed them."

Cal: "Of course I'd like to continue with the newsletter. They are always interesting and stimulating."

Yasuhiko: "I'm always interested in the USIT Newsletter especially the Mini Lectures"

Motoi: "I read your USIT Newsletter and the Mini Lectures, which are translated in Japanese by Professor Nakagawa'

Jayant: " I am extremely interested in the newsletter. Please keep it up."

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These and many more arrived and continue to arrive. Thanks for your encouragement.

5. Problem-Solving Tricks and Related Miscellany

7. Q&A

8. Other Interests

Several readers have inquired concerning availability of back issues of the newsletter. Please send your request by email and indicate the issue numbers you are interested in (NL_XX).

Please send your feedback and suggestions to Ntelleck@u-sit.net

To be creative, U-SIT and think.