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### <sup>2018</sup> The visual representation of complexity: Sixteen key characteristics of complex systems Boehnert, Joanna

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# The Visual Representation of Complexity: Sixteen Key Characteristics of Complex Systems



### Dr. Joanna Boehnert

Lecturer in Design Loughborough University, UK @Ecocene







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## 1. CECAN

- 2. Research Design
- 3. Key Characteristics
- 4. RSD6 Surveys
- 5. Workshops
- 6. Poster
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#### Welcome to CECAN

#### Read our latest Newsletter!

The Centre for the Evaluation of Complexity Across the Nexus (CECAN), a £3m research centre hosted by the University of Surrey, is transforming the practice of policy evaluation in Nexus areas, to make it fit for a complex world.

CECAN is pioneering, testing and promoting innovative policy evaluation approaches and methods across Nexus domains such as food, energy, water and the environment, through a series of 'real-life' case study projects with co-funders (ESRC, NERC, DEFRA, BEIS, FSA and EA).

CECAN has been delivering a programme of evaluation methods workshops, training courses in evaluation tools and specialist seminars delivered by international experts, to encourage knowledge sharing and capacity building amongst those working in UK policy making.

What is the Nexus and what do we do?...



Facebook





Original aim:

The identification, classification and design of visual codes to represent key features of complexity.





Initial research proposal title

The Visual Representation of Complex Systems:

A Typology of Visual Codes for Systemic Relations

Title after participatory workshops *The Visual Representation of Complexity: Sixteen Key Characteristics of Complex Systems* 





### The Research Process:



50 surveys at the Relating Systems Thinking and Design 6 conference in Oslo, Norway, October 2017.





List of Key Features of Complexity

- 1. Feedback (positive + negative)
- 2. Emergence
- 3. Self organization
- 4. Levers / hubs
- 5. Property non-linearity
- 6. Domains of stability / attractors
- 7. Adaptation
- 8. Path + path dependency
- 9. Tipping points
- 10. Boundary / Threshold
- 11. Change over time
- 12. Open system





Phase 1.

50 surveys distributed at RSD6.









- 46 surveys were collected in Oslo at RSD6
- See #RSD6 hashtag on Twitter for examples of audience participation
- A 'Visualising Complexity' Storify was created by CECAN collaborator Martha Bicket.

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Complexity Across the Nexu







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| Key concepts                         | Y/N Visualisation / Code / Symbol / tiny diagram, etc. | linked to #                                   |  |  |
| 1. Feedback<br>(positive + negative) | A->B A B   |   |  |  |
| 2. Emergence                         | A D  |   |  |  |
| 3. Self organization                 | >  |   |  |  |
| 4. Levers / hubs                     |  |   |  |  |
| 5. Property non-linearity            |  |   |  |  |
| 6. Domains of stability / attractors | )<br>)<br>(  |   |  |  |
| 7. Adaptation                        | ) / Pom pollinstos                                     | r<br>k  |  |  |
| 8. Path + path dependency            |  |   |  |  |
| 9. Tipping points                    | <u>.</u>   |   |  |  |
| 10. Boundary / Threshold             | -  |   |  |  |
| 11. Change over time                 | K,   |   |  |  |

The Visual Communication of Complex Systems: A Typology of Codes for Systemic Relations A project for CECAN - Centre for the Evaluation of Complexity Across the Nexus (Water-Energy-Food-Environment) Dr.Joanna Boehnert, jocehnert@eco-labs.org - Optional identifying information below

| Key concepts                         | Y/N              | Visualisation / Code / Symbol / tiny diagram, etc. | linked to # s |
|--------------------------------------|------------------|--|---------------|
| 1. Feedback<br>(positive + negative) | Y                | ູ່   |               |
| 2. Emergence                         | ۲                | ull  |               |
| 3. Self organization                 | Y                | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~             |               |
| 4. Levers / hubs                     | , Y <sup>4</sup> | Ĩ.   |               |
| 5. Property non-linearity            | ۲                |  |               |
| 6. Domains of stability / attractors | "Yu              | G  |               |
| 7. Adaptation                        | "Y"              | Ð  |               |
| 8. Path + path dependency            | ¥/~              | P  |               |
| 9. Tipping points                    | Y                | 2  |               |
| 10. Boundary / Threshold             | Y                | []   |               |
| 11. Change over time                 | Y                | -\$*   |               |
| 12. Open system                      | Yu               |  |               |

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| Key concepts                         | Y/N | Visualisation / Code / Symbol / tiny diagram, etc. | linked to # s |
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| 1. Feedback<br>(positive + negative) | Y   | 65   | 2             |
| 2. Emergence                         | 1   | RA20 .   | 3             |
| 3. Self organization                 | 4   | $\langle \rangle \rangle$                          | 2             |
| 4. Levers / hubs                     | 1   |  | 10            |
| 5. Property non-linearity            | 4   | ETUD   | 2             |
| 6. Domains of stability / attractors | 4   | No K   | 12            |
| 7. Adaptation                        | 4   | ·  | 3             |
| 8. Path + path dependency            | 14  | ANA CARA   | 16            |
| 9. Tipping points                    | Ń   |  |               |
| 10. Boundary / Threshold             | 4   | ER   | 12            |
| 11. Change over time                 | 1   | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~            | 2             |
| 12. Open system                      | Y   | AP?  | 10            |







| Key concepts                            | Y/N | Visualisation / Code / Symbol / tiny diagram, etc. linked to |
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| 1. Feedback<br>(positive + negative)    | 4   | Ð  |
| 2. Emergence                            | 9   | **   |
| 3. Self organization                    | 9   | <u> </u>   |
| 4. Levers / hubs                        | 3   |  |
| 5. Property non-linearity               | y   | Color Droge  |
| 6. Domains of stability /<br>attractors | 9   | The Box  |
| 7. Adaptation                           | 3   |  |
| 8. Path + path dependency               | N   |  |
| 9. Tipping points                       | 3   |  |
| 10. Boundary / Threshold                | N   |  |
| 11. Change over time                    | y   | MERAL DES  |
| 12. Open system                         | V   |  |

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| Key concepts                         | Y/N | Visualisation / Code / Symbol / tiny diagram, etc. | linked to # |
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| 1. Feedback<br>(positive + negative) | Y   | Ð  | 6           |
| 2. Emergence                         | У   | L'ALTON Estel                                      | 3,6,0       |
| 3. Self organization                 | Y   |  | 12          |
| 4. Levers / hubs                     | У   | - et   | 9,10        |
| 5. Property non-linearity            | (4) | ~  |             |
| 6. Domains of stability / attractors | 4)  |  |             |
| 7. Adaptation                        | 7   | TT-  |             |
| 8. Path + path dependency            | Y   |  |             |
| 9. Tipping points                    | Y   |  |             |
| 10. Boundary / Threshold             | Y   | ×  | -           |
| 11. Change over time                 | 4   | 200  |             |
| 2. Open system                       | 4   | -) (-  |             |

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| Key concepts                            | Y/N | Visualisation / Code / Symbol / tiny diagram, etc. | linked to # : |
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| 1. Feedback<br>(positive + negative)    | Ŷ   | ME-MOR >   |               |
| 2. Emergence                            |     |  |               |
| 3. Self organization                    |     |  |               |
| 4. Levers / hubs                        | N   |  |               |
| 5. Property non-linearity               | Y   |  |               |
| 6. Domains of stability /<br>attractors | N   |  |               |
| 7. Adaptation                           | Y   | Mile Marcel  |               |
| 8. Path + path dependency               |     |  |               |
| 9. Tipping points                       |     | $-\Theta_{\Delta}$                                 |               |
| 10. Boundary / Threshold                | М   |  |               |
| 11. Change over time                    | +   | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~            |               |
| 12. Open system                         | 4   | $\alpha$   |               |







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| Key concepts                         | Y/N | Visualisation / Code / Symbol / tiny diagram, etc. | linked to # s |
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| 1. Feedback<br>(positive + negative) | Y   |  |               |
| 2. Emergence                         | Y   | Ô  | #3            |
| 3. Self organization                 | Y   |  | <b>\$</b> 2   |
| 4. Levers / hubs                     | Y   |  |               |
| 5. Property non-linearity            | ٢   | J  | #1            |
| 6. Domains of stability / attractors | N   |  |               |
| 7. Adaptation                        | Y   |  | #1<br>#2      |
| 8. Path + path dependency            | N   | A Martin Contraction                               |               |
| 9. Tipping points                    | Y   |  |               |
| 10. Boundary / Threshold             | Y   |  |               |
| 11. Change over time                 | Y   |  | #5            |
| 12. Open system                      | Y   | 3.3.   |               |

| ey concepts                          | Y/N | Visualisation / Code / Symbol / tiny diagram, etc. | linked to # s |
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| 1. Feedback<br>(positive + negative) | Y   | (+*/(-)  |               |
| 2. Emergence                         | Y   | aleso  |               |
| 3. Self organization                 | γ   | •• - +   |               |
| 4. Levers / hubs                     | γ   | 200  |               |
| 5. Property non-linearity            | Y   | MAL  |               |
| 6. Domains of stability / attractors | У   |  |               |
| 7. Adaptation                        | У   |  |               |
| 8. Path + path dependency            | У   | Æ  |               |
| 9. Tipping points                    | У   | A  |               |
| 10. Boundary / Threshold             | Ŷ   | 1  |               |
| 11. Change over time                 | Y   | 0000   |               |
| 12. Open system                      | y   | to the   | 23            |

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| Key concepts   | Y/N | Visualisation / Code / Symbol / tiny diagram, etc. | linked to # s |
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| 1. Feedback<br>(Dositive + negative)<br>REINFERENCE & BALANC | V   | TE ET  |               |
| 2. Emergence   | Vi  |  |               |
| 3. Self organization   | Y   | a de traine  | - 149         |
| 4. Levers / hubs   | Y   | ×  | 12            |
| 5. Property non-linearity                                    | Y   | 407050   | 9/6           |
| 6. Domains of stability /<br>attractors                      | Y   |  | 5/9           |
| 7. Adaptation  | Y   | rrr  |               |
| 3. Path + path dependency                                    | Y   | -ulus-ur   | M             |
| . Tipping points   | Y   | R.   | 5/6           |
| 0. Boundary / Threshold                                      | Y   |  |               |
| 1. Change over time<br>WITAL COMPITIONS                      | Y   | x · · · · · · · · · · · · · · · · · · ·            | 8             |
| 2. Open system   | Y   | R A D  | 14            |





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| 1. Feedback<br>(positive + negative) |      | + +  |  |
| 2. Emergence                         |      | K & A T  |  |
| 3. Self organization                 |      | Z.   |  |
| 4. Levers / hubs                     |      | -0-0   |  |
| 5. Property non-linearity            |      | Anno   |  |
| 8. Domains of stability / attractors |      | -> @ +-  |  |
| 7. Adaptation                        |      |  |  |
| 8. Path + path dependency            |      | □>□  |  |
| 9. Tipping points                    |      | <u> </u>   |  |
| 10. Boundary / Threshold             |      | WOUlu  |  |
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| 12. Open system                      |      |  |  |

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| 1. Feedback                             | V   | A/S  |               |
| (positive + negative)                   | 1   | 51-  | -             |
| 2. Emergence                            | Y   | <u> </u>   |               |
| 3. Self organization                    | Y   |  |               |
| 4. Levers / hubs                        | ¥   |  |               |
| 5. Property non-linearity               | N   |  |               |
| 6. Domains of stability /<br>attractors | Y   | 0000   |               |
| 7. Adaptation                           | ¥   | 0-0-0-0  |               |
| 8. Path + path dependency               | 4   | 308  |               |
| 9. Tipping points                       | N   |  |               |
| 10. Boundary / Threshold                | Y   | Ó  |               |
| 11. Change over time                    | 4   | MS   | 1.0           |

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| 2. Emergence                            |     | 4  |                      |
| 3. Self organization                    |     | K  |                      |
| 4. Levers / hubs                        |     | Xo   |                      |
| 5. Property non-linearity               |     | 55   |                      |
| 6. Domains of stability /<br>attractors |     | ×//  |                      |
| 7. Adaptation                           |     | <i>\$</i>  |                      |
| 8. Path + path dependency               |     |  |                      |
| 9. Tipping points                       |     | $\sim$   | 1                    |
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| 2. Emergence                            | У   |  | -                |
| 3. Self organization                    | У   | or por or or   |                  |
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| 5. Property non-linearity               | N   |  |                  |
| 6. Domains of stability /<br>attractors |     | CA FR  |                  |
| 7. Adaptation                           |     | F  |                  |
| 8. Path + path dependency               |     |  |                  |
| 9. Tipping points                       | ¥   |  |                  |
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| 12. Open system                         |     | AXA  |                  |

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Name Alma Culén, Maja van der Velden X Ceccon Organisation Dept. of Informatics, UNIV. of OSLO Competent/Action the head

| Key concepts                            | Y/N | Visualisation / Code / Symbol / tiny diagram, etc. | linked to # s |
|---|-----|--|---------------|
| 1. Feedback<br>(positive + negative)    | Y   | 4 mm   | 3             |
| 2. Emergence                            | Y   | 111  | 3,12,8        |
| 3. Self organization                    | Y   | 2 fine   | 2,1,7         |
| 4. Levers / hubs                        | y   |  | 7             |
| 5. Property non-linearity               | Y   | $\sim$   | 9,6,12        |
| 6. Domains of stability /<br>attractors | Y   | X  | 9,10          |
| 7. Adaptation                           | 7   | And >  | 4,3,1         |
| 8. Path + path dependency               | Y   | 53   | 2             |
| 9. Tipping points                       | 7   | AIC  | 6,10          |
| 10. Boundary / Threshold                | Y   | $\bigcirc$   | 6,009         |
| 11. Change over time                    | Y   | -08  | 7             |
| 12. Open system                         | Y   | 711/   | 3,5           |

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| 2. Emergence                            |     | -sk-   |               |
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| 7. Adaptation                           |     |  |               |
| 8. Path + path dependency               |     | 7  |               |
| 9. Tipping points                       |     | - /  |               |
| 10. Boundary / Threshold                |     |  |               |
| 11. Change over time                    |     |  |               |
| 12. Open system                         |     | XERT   |               |

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| Key concepts                         | Y/N | Visualisation / Code / Symbol / tiny diagram, etc. | linked to # s |
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| 1. Feedback<br>(positive + negative) | ·   | Č.   |               |
| 2. Emergence                         | Y   | 0  |               |
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| 4. Levers / hubs                     | 4   | A  |               |
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| 6. Domains of stability / attractors | 4   | W/G  |               |
| 7. Adaptation                        | Y   | 000  |               |
| 8. Path + path dependency            | 4   | J.O.   |               |
| 9. Tipping points                    | 7   | A  |               |
| 10. Boundary / Threshold             | Y   | . (  |               |
| 11. Change over time                 | 4   | 142 + 142 - 1                                      |               |
| 12. Open system                      | N   |  |               |

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| 2. Emergence                            | Y   |   | #3                |
| 3. Self organization                    | Y   |   | #2                |
| 4. Levers / hubs                        | Y   |   | #9                |
| 5. Property non-linearity               | Y   | -nellenz  |                   |
| 6. Domains of stability /<br>attractors | N   | Iž  |                   |
| 7. Adaptation                           | Y   | <b>\$</b>   | #11               |
| 8. Path + path dependency               | Y   | AK  |                   |
| 9. Tipping points                       | ¥/N | Ĝ   | #4                |
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| 11. Change over time                    | Y   | 000000  | #7<br>#3          |
| 12. Open system                         | 4   |   |                   |

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Name JYOTIGH SONOWAL, NAMDINI KRISHNAMU CERETOR To COLONIA CONTRACTOR CONTRAC Organisation OCADU, MCKINSEY & CO. Key concepts Y/N Visualisation / Code / Symbol / tiny diagram, etc. linked to # s £.3. 1. Feedback 4 Y (positive + negative) 2. Emergence 3. Self organization N 4. Levers / hubs m 5. Property non-linearity 6. Domains of stability / N attractors 7. Adaptation 8. Path + path dependency ------9. Tipping points N (.) 10. Boundary / Threshold (4) N 11. Change over time 12. Open system Thank you for your help! Any comments or questions please email me at the address above.

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| ey concepts                             | Y/N | Visualisation / Code / Symbol / tiny diagram, etc. | linked to # s |
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| 12. Open system                         |     |  |               |

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Y/N Visualisation / Code / Symbol / tiny diagram, etc. linked to # s 1. Feedback + -(positive + negative) ない 2. Emergence PDex 0 3. Self organization 4. Levers / hubs V 5. Property non-linearity C 6. Domains of stability / attractors 7. Adaptation 8. Path + path dependency 9. Tipping points FRA YOU WALL NOT PASSIS. 10. Boundary / Threshold (145)

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Cecan Entre for the Evaluation of Complexity Across the News

Dr. Joanna Boehnert, jboehnert@eco-labs.org - Optional identifying information below

Name LAUCA HALLERAN Organisation OCAD UNIVERSITY

Key concepts

11. Change over time

12. Open system

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| Key concepts                         | Y/N | Visualisation / Code / Symbol / tiny diagram, etc. | linked to # : |
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| 1. Feedback<br>(positive + negative) | Y   | <u> </u>   | 117           |
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| 3. Self organization                 | N   | Jos o Tama   |               |
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| 10. Boundary / Threshold             | 4   | Ĭ  |               |
| 11. Change over time                 | y   | • • • • • • • • • • • •                            |               |
| 12. Open system                      | N   | • • • • • • • • • • • • •                          |               |







A project for CECAN - Centre for the Evaluation of Complexity Across the Nexus (Water-Energy-Food-Environment) Dr.Joanna Boehnert, jboehnert@eco-labs.org - Optional identifying information below

| Key concepts                            | Y/N | Visualisation / Code / Symbol / tiny diagram, etc.   | linked to # s |
|---|-----|--|---------------|
| 1. Feedback<br>(positive + negative)    | Y   | * \$ *\$   |               |
| 2. Emergence                            | Y   | 9  |               |
| 3. Self organization                    | Y   | A.   |               |
| 4. Levers / hubs                        | Y   | ×.   |               |
| 5. Property non-linearity               |     |  |               |
| 6. Domains of stability /<br>attractors | Y   | 4  |               |
| 7. Adaptation                           | Ч   | Chilling and the second |               |
| 8. Path + path dependency               | У   | 1/2  |               |
| 9. Tipping points                       | Ч   | ھ  |               |
| 10. Boundary / Threshold                | Y   | 送秋   |               |
| 11. Change over time                    | Ч   | 0  |               |
| 12. Open system                         | 7   | A.   |               |

Thank you for your help! Any comments or questions please email me at the address above.

The Visual Communication of Complex Systems: A Typology of Codes for Systemic Relations A project for CECAN - Centre for the Evaluation of Complexity Across the Nexus (Water-Energy-Food-Environment) Dr.Joanna Boehnert, boehnert@eco-labs.org - Optional identfying information below



The Visual Communication of Complex Systems: A Typology of Codes for Systemic Relations A project for CECAN - Centre for the Evaluation of Complexity Across the Nexus (Water-Energy-Food-Environment) Dr. Joanna Boehnert, jooehnert@eco-labs.org - Optional identifying information below Cecan Name Organisation\_ Y/N Visualisation / Code / Symbol / tiny diagram, etc. linked to # s Key concepts 1. Feedback 20> (positive + negative) 2. Emergence 000 3. Self organization -0-N 4. Levers / hubs m N 6 5. Property non-linearity 5 6. Domains of stability / attractors -0-7. Adaptation 8. Path + path dependency TI 6 9. Tipping points 5 10. Boundary / Threshold 11. Change over time 12. Open system Thank you for your help! Any comments or questions please email me at the address above.







| ame                                  | ×.   | entre for the Evaluation<br>omplexity Across the Nel |
|--------------------------------------|--|--|
| Key concepts                         | Y/N Visualisation / Code / Symbol / tiny diagram, et | c. linked to # s                                     |
| 1. Feedback<br>(positive + negative) | + 04   |  |
| 2. Emergence                         | וווופות  |  |
| 3. Self organization                 |  |  |
| 4. Levers / hubs                     |  |  |
| 5. Property non-linearity            |  |  |
| 6. Domains of stability / attractors | 0]0]   |  |
| 7. Adaptation                        |  |  |
| 8. Path + path dependency            | Or with  |  |
| 9. Tipping points                    |  |  |
| 10. Boundary / Threshold             | <u>no</u>  |  |
| 11. Change over time                 | Call Constant  |  |
| 12. Open system                      | C  |  |

A project for CECAN . Castra for the Evalu

The Visual Communication of Complex Systems: A Typology of Codes for Systemic Relations A project for CECAN - Centre for the Evaluation of Complexity Across the Nexus (Water-Energy-Food-Environment) Dr.Joanna Boehnert, jboehnert@eco-labs.org - Optional identifying information below

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| Key concepts                         | Y/N | Visualisation / Code / Symbol / tiny diagram, etc. | linked to # s |
|--------------------------------------|-----|--|---------------|
| 1. Feedback<br>(positive + negative) | 7   | Qt)  |               |
| 2. Emergence                         | Y   | -0.00  |               |
| 3. Self organization                 | Y   |  | 1.0           |
| 4. Levers / hubs                     | 4   | 600  |               |
| 5. Property non-linearity            | Y   | Pris?  |               |
| 6. Domains of stability / attractors | Y   | 00   |               |
| 7. Adaptation                        | Y   | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~             |               |
| 8. Path + path dependency            | Y   | ¥26  |               |
| 9. Tipping points                    | 4   | 070  |               |
| 10. Boundary / Threshold             | 4   | Æ  |               |
| 11. Change over time                 | Y   | 1~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~            |               |
| 12. Open system                      | Y   | (d)  |               |

The Visual Communication of Complex Systems: A Typology of Codes for Systemic Relations A project for CECAN - Centre for the Evaluation of Complexity Across the Nexus (Water-Energy-Food-Environment) Dr.Joanna Boehnert, jboehnert@eco-labs.org - Optional identifying information below Name Julia Andreyeva Organisation Stuclen, Hochschule Hannover, Germany Congeneration Stucker, Norder to Hannover Key concepts Y/N Visualisation / Code / Symbol / tiny diagram, etc. linked to # s andreyeval web.de 1. Feedback -(positive + negative) ....I 2. Emergence Y The Tm Y 3. Self organization Dr . silii 4. Levers / hubs Y Y 5. Property non-linearity 6. Domains of stability / Y attractors Y 7. Adaptation 00000 8. Path + path dependency 9. Tipping points 10. Boundary / Threshold 11. Change over time 6 12. Open system

Thank you for your help! Any comments or questions please email me at the address above.







|                                      |  | energy worldss she has |
|--------------------------------------|--|------------------------|
| Key concepts                         | Y/N Visualisation / Code / Symbol / tiny diagram, etc. | linked to # s          |
| 1. Feedback<br>(positive + negative) |  |                        |
| 2. Emergence                         | A Date a st  | 3                      |
| 3. Self organization                 | <i>•</i>   | 2                      |
| 4. Levers / hubs                     | ****   |                        |
| 5. Property non-linearity            |  |                        |
| 6. Domains of stability / attractors | *  |                        |
| 7. Adaptation                        |  |                        |
| 8. Path + path dependency            | 0000   | 13                     |
| 9. Tipping points                    | Tan  |                        |
| 10. Boundary / Threshold             | <br>   | 17                     |
| 1. Change over time                  | Ymm-   | 8                      |
| 2. Open system                       | (3.  | 16                     |

-The Visual Communication of Complex Systems: A Typology of Codes for Systemic Relations A research project for CECAN - Centre for the Evaluation of Complexity Across the Nexus (Water-Energy-Food) Dr.Joanna Boehnert, jboehnert@eco-labs.org. Optional identifying information below MEX PEN. COLAN Name Cecan Centre for the Evaluation of Complexity Across the Nexas Organisation\_\_\_ Y/N column: are you familiar with this concept? Key concepts Y/N visualisation / code / symbol / tiny diagram, etc. linked to # s 1. Feedback 3 m 2. Emergence 3. Self organization 1,15 4. Levers / hubs 5. Property non-linearity 6. Domains of stability / attactors 7. Adaptation EE 8. Path + path dependency T Thank you for your help. Please send by post or scan of both sides of this form and return by email. Deadline: 12 December 2017









| Key concepts                            | Y/N | Visualisation / Code / Symbol / tiny diagram, etc. | linked to # s |
|---|-----|--|---------------|
| 1. Feedback<br>(positive + negative)    | Y   |  |               |
| 2. Emergence                            | not | ···  |               |
| 3. Self organization                    | Y   | A 883  |               |
| 4. Levers / hubs                        |     | €  |               |
| 5. Property non-linearity               |     |  |               |
| 6. Domains of stability /<br>attractors |     | 9  |               |
| 7. Adaptation                           | 7   | (7=755) (d. barbapapa)                             |               |
| 8. Path + path dependency               |     |  |               |
| 9. Tipping points                       |     | A  |               |
| 10. Boundary / Threshold                |     |  |               |
| 11. Change over time                    |     | 100  |               |

| Key concepts                              | Y/N | visualisation / code / symbol / tiny diagram; etc. | linked to # s    |
|---|-----|--|------------------|
| 9. Tipping points                         | Y   | HALF THE D   | 10,              |
| 10. Boundary / threshold<br>Tipping point | Y   | 1  | 6, 9             |
| 11. Change over time                      |     | J. City  | 13,17            |
| 12. Open system                           |     |  | 13               |
| 13. Unpredictability                      |     | · · · · · · · · · · · · · · · ·                    | 12,7,5<br>2,11,8 |
| 14. Unknowns                              |     |  | 13<br>12         |
| 15. Distributed control                   |     | 46 °Q.   | 3                |
| 16. Nested systems                        |     |  | 17               |
| 17. Multiple scales                       |     | of log and   | 3 /6             |











ama myterity ol / tiny diagram, et 500 @ Manuela Aguirre U #RSDG Feedback 10000 m Emergence letions Stall Rig self oy levers Non-linearity = Stability / attractors Adaptation  $\rightarrow$ Proots influence routes. path dependency Tipping points 1-余. Bundowy / thurshold 0000 A+B-C+D-> Change over time 2 dr open system.









#### Uttisht @UttishtV · 20 Oct 2017

When you have an audience, participatory design ensues **#RSD6** 

| 1. Fe<br>(posi | edback<br>tive + negative)     | C                    |
|----------------|--------------------------------|----------------------|
| 2. Er          | nergence                       | - Alto               |
| 3. Se          | elf organization               | 0000<br>0000<br>0000 |
| 4. Le          | evers / hubs                   | TT?                  |
| 5. Pi          | roperty non-linearity          |                      |
| 6. Do<br>attra | omains of stability /<br>ctors | -Zo                  |
|                |                                |                      |



V

#### **lucy kimbell** @lixindex · 20 Oct 2017 Loving the visual task for @Ecocene #RSD6 even if I can't draw







V

The images were collected in the surveys and used in two participatory design workshop in London.

November 17 & December 15, 2017

The Visual Communication of Complex Systems Name

| Key concepts                        | Y/N | comments | A/B/C/D/E/F |
|-------------------------------------|-----|----------|-------------|
| 1. Feedback                         |     |          |             |
| 2. Emergence                        |     |          |             |
| 3. Self organization                |     |          |             |
| 4. Levers / hubs                    |     |          |             |
| 5. Property non-linearity           |     |          |             |
| 6. Domains of stability / attactors |     |          |             |
| 7. Adaptation                       |     |          |             |
| 8. Path + path dependency           |     |          |             |
| 9. Tipping points                   |     |          |             |
| 10. Boundary / threshold            |     |          |             |
| 11. Change over time                |     |          |             |
| 12. Open system                     |     |          |             |
| 13. Unpredictability                |     |          |             |
| 14. Unknowns                        |     |          |             |
| 15. Distributed control             |     |          |             |
| 16. Nested systems                  |     |          |             |
| 17. Multiple scales                 |     |          |             |





### **Key Characteristics of Complexity**

- 1. Feedback (positive + negative)
- 2. Emergence
- 3. Self organization
- 4. Levers / hubs
- 5. Property non-linearity
- 6. Domains of stability / attractors
- 7. Adaptation
- 8. Path + path dependency
- 9. Tipping points
- 10. Boundary / Threshold
- 11. Change over time
- 12. Open system

### **Key Characteristics of Complexity**

- 1. Feedback (positive + negative)
- 2. Emergence
- 3. Self organization
- 4. Levers and hubs
- 5. Non-linearity
- 6. Domains of stability
- 7. Adaptation
- 8. Path + path dependency
- 9. Tipping points
- 10. Change over time
- 11. Open system
- 12. Unpredictability
- 13. Unknowns
- 14. Distributed Control
- 15. Nested systems
- 16. Multiple Scales





, Feedback

































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# Outcomes

1) Visual Outcomes: Poster

'A Typology of Visual Codes for Systemic Relations'

2) Content for the Magenta Book Annexe Complexity Characteristics

3) Journal Paper (in progress)'The Visual Communication of Complexity'

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![](_page_40_Picture_6.jpeg)

### **THE VISUAL REPRESENTATION OF COMPLEXITY** \* Definitions, Examples & Learning Points \*

Sustainability practitioners have long relied on images to display relationships in complex adaptive systems on various scales and across different domains. The Visual Representation of Complexity research project addresses the need for images that are widely understood across different fields and sectors for researchers, policy makers, design practitioners and evaluators with varying degrees of familiarity with complexity science. This research identifies, defines and illustrates 16 key features of complex systems and contributes to an evolving visual language of complexity. Ultimately the work supports learning as a basis for informed decision-making at CECAN (Centre for the Evalutation of Complexity Across the Nexus) and other communities engaged with the analysis of complex problems.

A research process was designed to identify sixteen key characteristics of complexity and to inform the development of new images and descriptions. In order to gather ideas from academics, sustainability practitioners and designers with expertise in the complexity sciences, systems mapping and design, Joanna Boehnert collected 50 surveys at The Environment, Economy, Democracy: Flourishing Together RSD6 (Relating Systems Thinking and Design) conference in Oslo (October 2017) and ran two participatory workshop in London (November and December 2017). The images, definitions, examples and learning points were developed with this process. The text below was written by Alex Penn, Pete Barbrook-Johnson, Martha Bicket and Dione Hills and edited by Joanna Boehnert. Many thanks to RSD6 organisers and all who contributed images and ideas in the surveys and workshops.

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Centre for the Evaluation of Complexity Across the Nexus

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OANNA BOEHNER

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### Dr. Joanna Boehnert

Lecturer Loughborough University, UKL https://ecolabsblog.wordpress.com

Twitter: @ecolabs + @ecocene

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![](_page_57_Picture_8.jpeg)