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Universal Design of Clinical and Translational Science for Improved Human Service Outcomes

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Integrated Research/Practice Networks

Increased cultural diversity, changing demographics, and an expanding legislative mandate to reduce unemployment of persons with disabilities call for enhanced vocational rehabilitation service levels, even as the resource base is dwindling. Use of *Universal Design* principles in knowledge translation can ensure the flow of action-oriented knowledge of research findings and best practices to practitioners, consumers, educators, and researchers, when and where it is needed. Such an approach can support the requirements of translational science. More detailed and timely communication and collaboration patterns will enhance quality of service and improve employment outcomes.

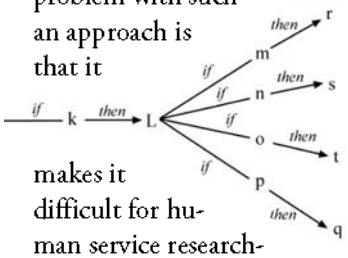
Use of technology to systematically collect and manage data using simple, universal knowledge models can support rapid documentation and assessment of client conditions.

The project uses generative taxonomy models to combine self-management and career success strategies from the literature, Dept. of Labor O*NET models, and the ICF Checklist of Functioning, Disability, and Health. Using Web-based devices, clients and service providers make choices and enter data, only encountering questions that relate to their own characteristics and preferences. Reports are generated based on up to five levels of priority from fifteen options. These include:

- Personal job interest
- Income maximization
- Benefits maximization
- Available job match
- Current primary interest
- Future primary interest
- Geographical proximity
- Education and training match
- Abilities and skills match
- Work style match
- Experience match
- Accommodation category
- Least cost for accommodation

Parsimony as the Key to Complexity

Traditional approaches to knowledge representation are highly complex, requiring months if not years of study and practice before designers can create meaningful content. This is particularly the case for process-oriented forms of knowledge, the knowledge of "how" as opposed to the knowledge of "what". The problem with such an approach is that it



makes it difficult for human service researchers and administrators to make use of such tools to transfer their knowledge via technology to practitioners and clients in the field. The purpose of this project is to test the proposition that complex sets of conditions can be modeled using simple models.

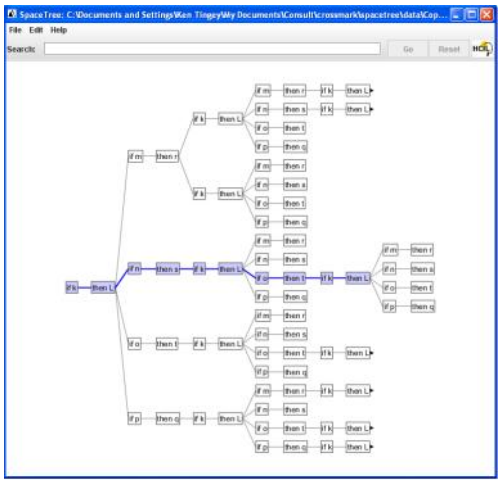
Special Points of Interest

- *Universal Design of knowledge representation can apply at the junction of research and practice in human services*
- *Universal Design of knowledge tools allows for fluid collaboration among experts and authorities in the development of comprehensive solution networks*
- *The characteristics and needs of individuals, particularly persons with disabilities, cannot adequately be reflected in simplistic models*

Inside this handout:

Literature Review

In human services, *Universal Design* is at the junction of research and practice.



Whether knowledge representation needs to be complex is a proposition that has not adequately been studied.

Fluidity, the flow of knowledge from experts and authorities to their targeted user communities by means of technology, can result from parsimonious, universal *logic* design.

With simplicity, fluidity can become the basis for complex, multimodal, multidisciplinary translational science. Fluidity has been described in various literatures related to technology and the use of electronic systems and networks. No single approach to fluidity has been fully developed for general use.

Based on the work of Allen (1983, 2004), closely following the description of *modus ponens* (if p, then q) of Aristotle, a simple model for knowledge design can be derived. By extending this approach, a tree-based model for describing process-oriented knowledge forms can be used to computerize such knowledge. Using this approach, knowledgeable parties can take *tacit* and *explicit* knowledge forms and extend them to *active*, process-oriented forms.

Research Questions

1. Can parsimonious logical models based on modus ponens support complexity?

2. Can such models foster interdisciplinary knowledge translation and collaboration among researchers, educators, and practitioners?

3. What information processing advantages and disadvantages are brought about through use of such models?

If an open framework based on *Universal Design* is effective, there are important implications with regard to the direction of research, as it allows for a higher level of integration among research models and practices in the field. Higher levels of collaboration among researchers and practitioners would open up new avenues of study.

Methodological Approaches

The project combines widely-supported human services and scientific models, The U. S. Department of Labor O*NET models and the World Health Organization International Classification of Functioning, Disability, and Health (ICF).

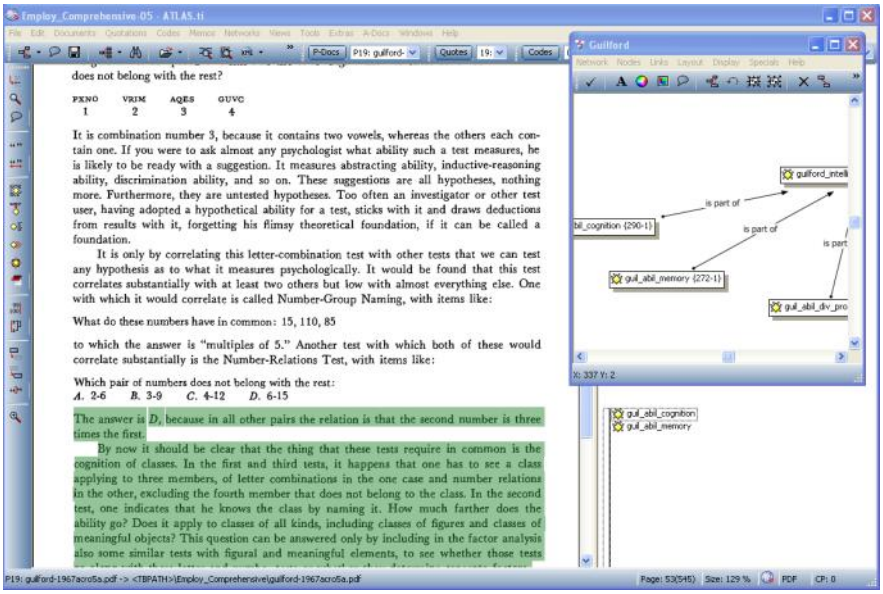
Career strategy and understanding, ability, and affect models are also introduced to provide additional context for job-find strategies for users and service providers.

The project also makes use of the *Tacit/Explicit/Expressive* approach to knowledge structure (Tingey 2008, 2009) based on parsimonious Aristotelian tree models to outline process models. Such models are designed to facilitate translating knowledge across disciplines as outlined in the models.

Similar tree models are used for collecting and evaluating content based on vocational rehabilitation objectives.

Grounded Theory and Translational Science

Although the need for effective translational science is unquestioned, its characteristics are not clearly understood. Philosophically, a means of sharing the fruits of scientific inquiry among researchers, engineers, practitioners and others is referred to as knowledge translation, the science of science, knowledge management, and knowledge utilization and dissemination. (Dougherty, 2009) The process requires not only translation among people, but between people and machines, complicating the process to a significant degree. Universal logic design as a means of encouraging dissemination. Grounded theory, a means of consolidating knowledge from a variety of sources and models (Charmaz, 2006; Glaser & Strauss, 1967/1999). The models outlined herein were developed using grounded theory approaches as a means of preparing content for the logic models.



Atlas.ti workspace

Note on Technology

Grounded theory analysis was supported through use of *Atlas.ti* software, a personal computer application that supports coding, classification, and semantic model building using various source documents at data (Muhr, 2004). The accompanying graphic "Atlas.ti workspace" provides some idea of the nature of the task. Most of the referenced articles on page 11 herein are referenced and coded within *Atlas.ti*, with the result that comprehensive models can be designed that supersede the contents of a particular source document. A page from Guilford (1967) appears in the panel to the left while the two codes in the panel to the bottom/right are linked to the highlighted code. Those codes, "guil_abil_cognition" and "guil)abil_memory" show up in the separate window to the upper right. The first number in brackets in the model in each case refer to the number of codings for each among all sources.

The Comprehensive Abilities Model (see pages 4 and 5)

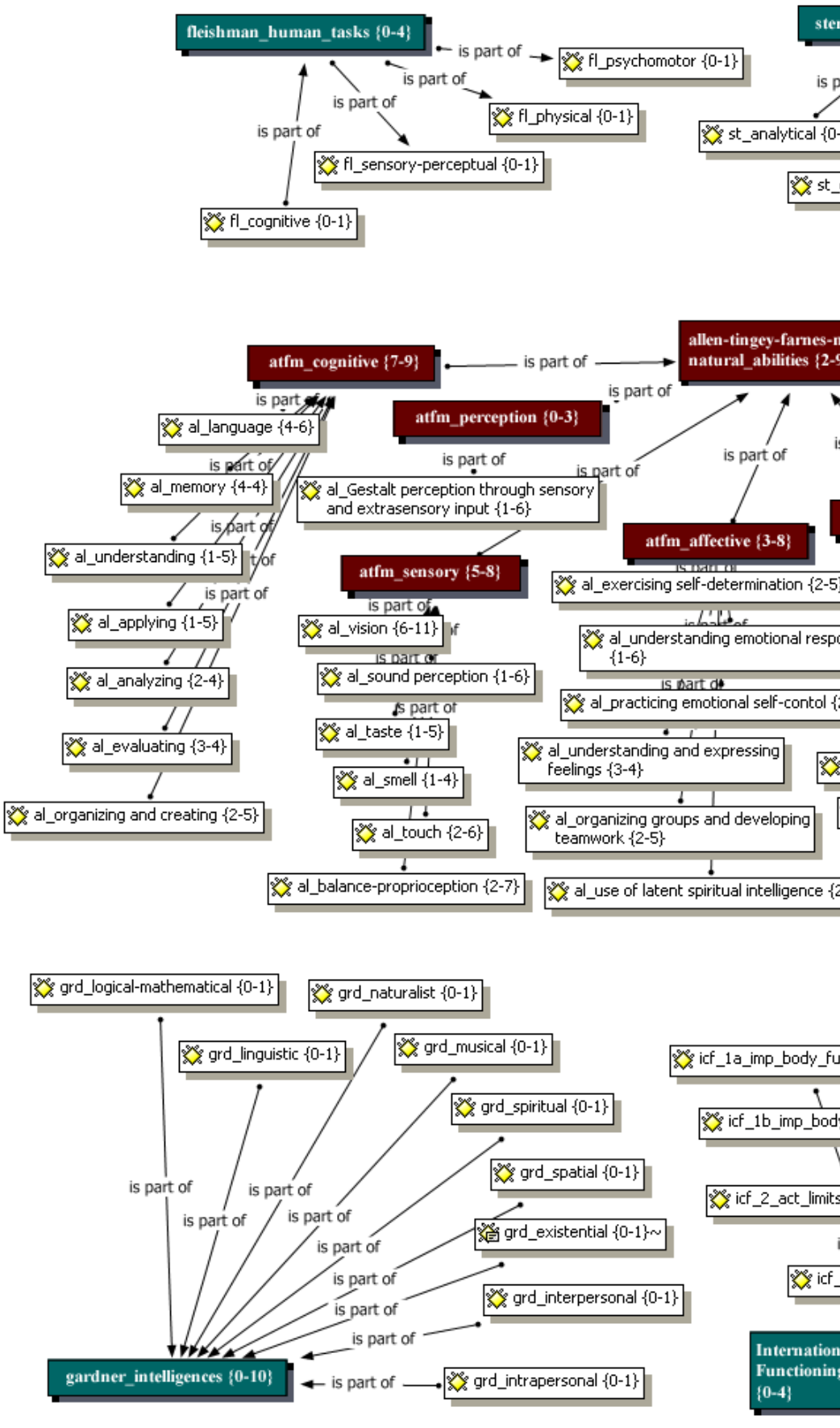
Use of the simple tree model allows for unrestrained logic design. We could consider issues in novel ways. A parallel grounded theory development effort by Allen, Tingey, Farnes, and Millington (2010) to derive a comprehensive model representing the universe of human abilities was helpful. The project leveraged that work in spite of its complexity.

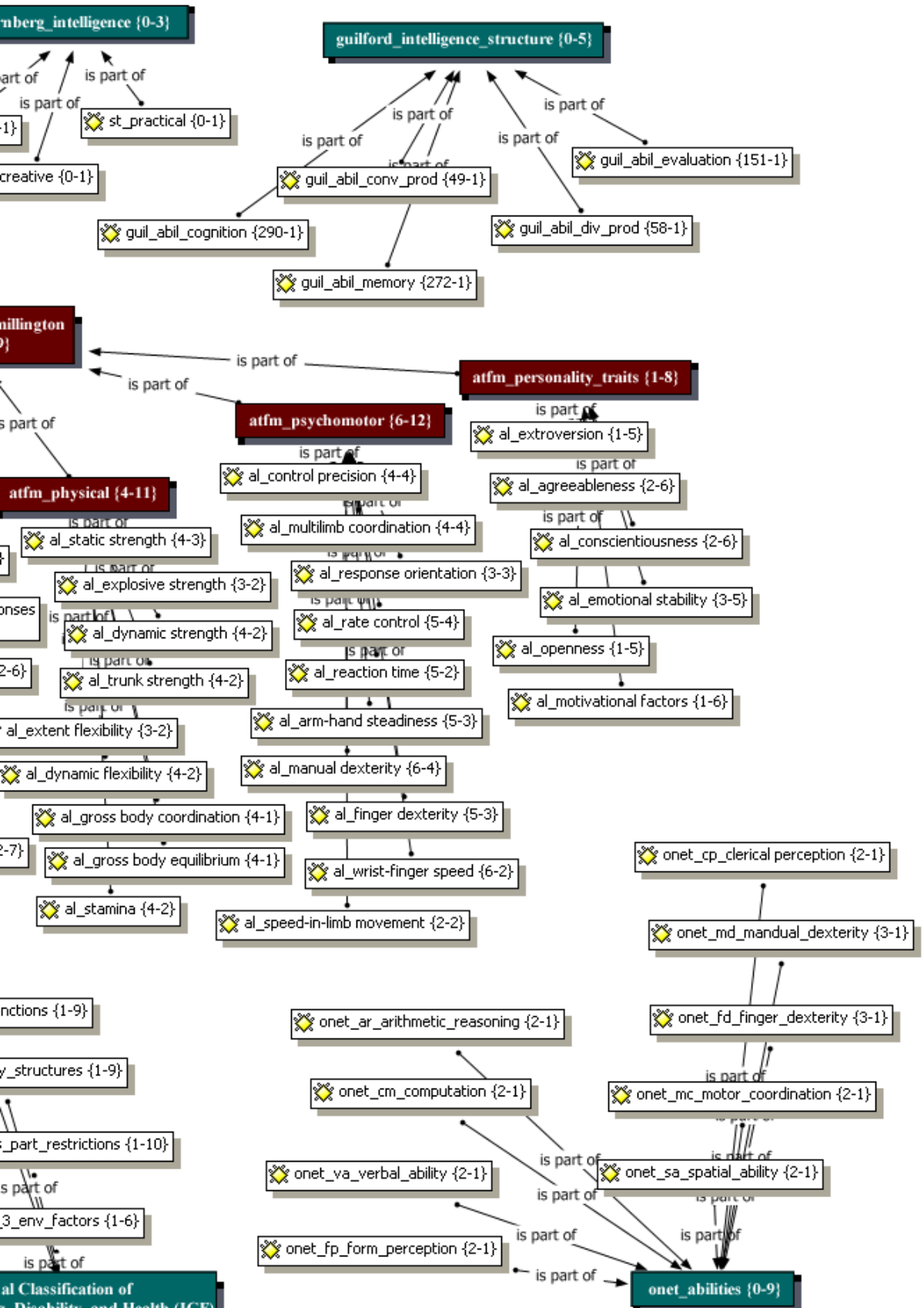
The Allen, Tingey, Farnes, Millington (ATFM) model is organized within seven categories, each representing classes of abilities. For example, the code "atfm_cognitive" represents seven types of cognitive abilities that have been identified. Each subcategory is shown with connecting arcs. In all, approximately 200 abilities have been identified to date, with an effort to identify available instruments to assess each ability.

The ATFM ability model is informed by the works of Fleishman (1984, 2008), Sternberg (1988, 2000), Guilford (1967), and Gardner (1983, 1999). ICF (WHO 2001, 2003) and O*NET (ETA, 2002) models are also referenced. Led out by investigation by Allen, these various models are being studied with the objective of combining the benefits of *Universal Design* and available translational tools to provide the capacity for complete assessment of abilities as quickly, conveniently, and inexpensively as possible.

Existing work can provide a baseline for detailed study of the needs and opportunities available to individuals with a strong understanding of their natural abilities.

The Comprehensive Abilities Model




guilford_intelligence_structure {0-5}
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guil_abil_evaluation {151-1}
guil_abil_conv_prod {49-1}
guil_abil_cognition {290-1}
guil_abil_div_prod {58-1}
guil_abil_memory {272-1}
atfm_personality_traits {1-8}
atfm_psychomotor {6-12}
atfm_physical {4-11}
al_extroversion {1-5}
al_control precision {4-4}
al_agreeableness {2-6}
al_multilimb coordination {4-4}
al_conscientiousness {2-6}
al_static strength {4-3}
al_response orientation {3-3}
al_explosive strength {3-2}
al_emotional stability {3-5}
al_rate control {5-4}
al_dynamic strength {4-2}
al_openness {1-5}
al_reaction time {5-2}
al_trunk strength {4-2}
al_motivational factors {1-6}
al_arm-hand steadiness {5-3}
al_extent flexibility {3-2}
al_manual dexterity {6-4}
al_dynamic flexibility {4-2}
al_finger dexterity {5-3}
al_gross body coordination {4-1}
al_gross body equilibrium {4-1}
al_wrist-finger speed {6-2}
al_stamina {4-2}
al_speed-in-limb movement {2-2}
onet_cp_clerical perception {2-1}
onet_md_mandual_dexterity {3-1}
onet_fd_finger_dexterity {3-1}
onet_ar_arithmetic_reasoning {2-1}
onet_cm_computation {2-1}
onet_mc_motor_coordination {2-1}
onet_va_verbal_ability {2-1}
onet_sa_spatial_ability {2-1}
onet_fp_form_perception {2-1}
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is part of

Multi-Phase Evaluation Model (CAMEO) (see pages 8 and 9)

The network figure to the right outlines six steps that represent an inclusive approach to meeting the needs of all individuals, including those that have disabilities in some areas. The dialog box to the left of the network figure is representative of the *Universal Design* demonstration that accompanies this information. That demonstration has been given the name *Comprehensive Approach to Maximizing Employment Outcomes (CAMEO).*

Step 1. The Allen, Tingey, Farnes, Millington (ATFM) abilities model, as seen to the bottom right of the figure, serves as the basis for initial or early stage evaluation of a person's abilities. This is to help to provide support and preparation and possible support if disabilities are evident.

Step 2. Preparation can be organized to take into account assistance from members of a person's nurturing group and his or her support group — a combination of helpers the represent relatives, other interested parties, and educational and possibly human service professionals. Abilities are enhanced, it is hoped, and skills are developed in this stage as needs and opportunities become apparent.

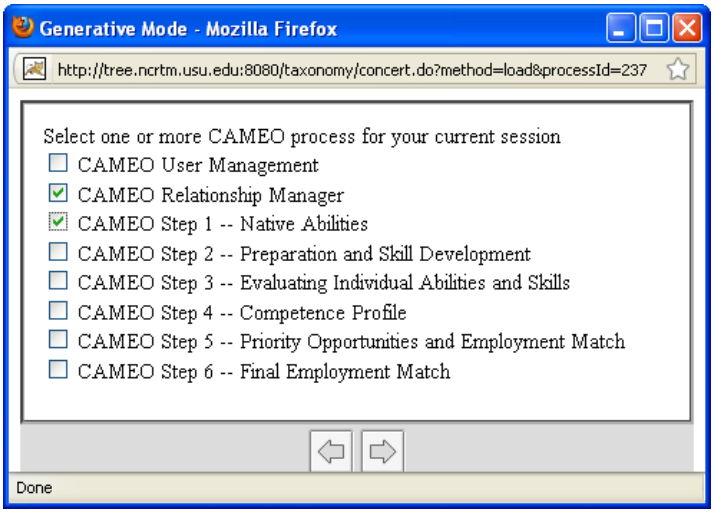
Step 3. At some point in a person's development, possibly on several occasions, a full review of that person's profile of abilities and skills is warranted. If education and training and other forms of preparation were aligned with a person's strengths, the skills thus developed would be likely to be supported by the person's natural abilities.

Evaluations carried out in Step 3 include perceptions by the person as well as each participant in his or her nurturing and service groups. This approach views abilities in a novel way. They are evaluated based on a six-point scale, each ability in its due course: "ability_not_known", "gift", "strength_talent", "typical", "weakness", or "disability".

Of course, with 200 abilities in question, the great majority of these will fit in the category "ability_not_known". Though many instruments and tests exist to support valid assessment of most of the abilities in question, they are not readily available in their entirety. Furthermore, cost and time limitations make full assessment improbable, though arguably beneficial. A particular loss is in not being able to fully certify that a person's gifts and talents are understood, resulting in personal loss as well as a loss to society. The *Universal Design* approach is undertaken with the objective of making full ability assessments practical and commonplace.

Step 4. Development of a *Competence Profile* is considered a fundamental objective of the CAMEO approach. Development of models. Such profiles will take into account evaluations of all abilities by all relevant parties and possible accommodations for disabilities.

Step 5. As shown on page 7, this step is intended to support "what if" analysis of a person's employment prospects. These reports can be organized to take advantage of large stores of semantic and variable date as shown on page 6.



MODEL CHARACTERISTICS

The computerized model in question, to be demonstrated, is comprised of three parts, all housed in Aristotelian trees using generative taxonomies. In all, approximately one hundred process trees are represented in the model. Each of the trees has varying numbers of branches, depending on the requirements of each process type. Approximately forty of these processes relate to the ICF model alone. Approximately thirty apply to O*NET issues and supporting instruments. The remaining process trees support employment strategy issues and evaluation processes.

The model is designed to support all potential responses to questions as they arise, including the existence of conditions and measures of severity, meaningfulness, etc. Though there are hundreds of potential questions as can potentially be asked of a particular user, the nature of the tree-based model is such that each user will only be presented questions and information as they apply to that person's individual case. Nonetheless, as can be seen in the panel to the right, hundreds of conditions can be identified and recorded in such sessions.

407 semantic items representing one case

ONET_WA_21_D, B167I, B3I, E125BF, D710_AL2, ONET_AQ_NOW, ONET_WA_153_D, ONET_WA_78_D, ONET_WA_129_D, D530_R1, ONET_WA_74_D, ONET_WA_125_D, D720AL, D470AL, ONET_WA_42_U, E540_F1 , ONET_WA_70_D, ONET_WA_121_D, CJOB_1-3, E355_F2, B2I, ONET_WA_46_D, ONET_WS_NOW, JR_TALENT_ENC-SISTER, ONET_WA_14_U, D930AL, D870_AL3, ONET_WA_174_U, E3BF, ONET_WA_18_D, E420BF, D145_AL2, ONET_WA_178_D, S110_C5, D470_AL2, D940_AL2, ONET_AP_NOW, ONET_WA_99_D, ONET_WA_91_U, ONET_WA_142_U, B1I, ONET_WA_10_D, ONET_WA_67_U, TALENT37-0000, ONET_WA_170_D, D720R, ONET_WA_95_D, ONET_WA_146_D, D440_R2, D620AL, ONET_WA_114_U, E450_F2, E590BF, D440R, D175_R2, ONET_WA_118_D, E110BF, ONET_WA_110_U, B164I, D830AL, ONET_WA_63_D, ONET_WA_39_D, E320BF, JZ_FUT_2, ONET_WA_35_D, JR_TALENT_WORK, D475R, ONET_WA_31_D, ONET_WA_139_U, D770_AL3, ONET_WA_167_D, ONET_WA_6_D, D350_R2, ONET_WA_163_D, ONET_WA_2_L, ONET_WA_88_D, D6AL, E440_F1, JR_TALENT_EMPL-SPEC, E360_F2, JR_TALENT_ENC-UNCLE, ONET_WA_84_D, ONET_WA_80_L, ONET_WA_135_D, D2AL, D730AL, ONET_WA_52_U, D860_AL2, ONET_WA_131_D, D330R, ONET_WA_56_D, ONET_WA_107_D, ED_NOT_HS, D940AL, D930_AL2, ONET_WA_103_D, ONET_WA_28_D, ONET_WA_24_D, D530_AL1, ONET_WA_152_U, ONET_WA_20_D, ONET_WA_180_D, E325_F2, ONET_WA_156_D, ONET_WA_73_U, ONET_WA_77_L, B117I, D150_AL2, ONET_WA_128_D, D620_AL1, ONET_WA_45_U, ONET_WA_124_D, ONET_WA_49_D, D220_AL1, E330BF, D445AL, ONET_WA_120_D, MALE, D760_AL2, ONET_WA_41_L, D330_R3, ONET_WA_173_U, ONET_WA_98_U, E540BF, ONET_WA_17_D, E420_F1, E340_F3, B310_I3, D145_R2, ONET_WA_177_D, D7R, ONET_WA_13_D, D530AL, ONET_WA_149_D, D850_AL3, ONET_WA_117_U, JR_TALENT_ENC-FATHER, E355BF, TALENT21-0000, ONET_WA_94_D, ONET_WA_145_D, D740AL, D470R, ONET_WA_90_D, ONET_WA_38_U, D920_AL2, ONET_WA_141_D, ONET_WA_66_D, D6R, S110I, VISITIMPAIR, B167_I3, D950AL, TALENT35-0000, ONET_WA_62_D, S110C, ONET_WA_113_D, D220AL, JR_TALENT_ENC-OTHERS, D150R, ONET_WA_30_U, E440BF, E410_F1, E330_F2, ONET_WA_34_D, D5R, D140_AL3, ONET_WA_9_D, ONET_WA_166_D, D9AL, D640AL, ONET_WA_5_D, ONET_WA_162_D, D640R, ONET_WA_87_D, JR_TALENT_ENC-AC-ADV, D5AL, ONET_WA_138_D, ONET_WA_134_L, D145R, ONET_WA_1_D, ONET_WA_55_U, D850AL, ONET_WA_83_D, D1AL, D750_AL1, ONET_WA_59_D, D4R, B152I, E340BF, ONET_WA_130_D, COGNITIVEIMPAIR, D150_R2, -E5, -E4, E320_F1, D350_AL2, ONET_WA_106_D, -E3, -E2, D820_AL3, D770_R3, B210_I1, D330AL, ONET_WA_51_D, ONET_WA_102_D, E550BF, ONET_WA_27_D, ONET_WA_23_D, D3R, -D9, -D8, TALENT27-0000, ONET_WA_159_D, ONET_WA_151_U, D440_AL1, D145AL, D910_AL2, ONET_WA_127_U, -D2, ONET_WA_155_D, D750AL, D530R, D140_R3, ONET_WA_76_D, E310_F3, E575BF, ONET_WA_72_D, ONET_WA_123_D, E125_F1, ONET_WA_48_D, E450BF, ONET_WA_44_D, E585_F2, E5BF, ONET_WA_40_D, ONET_WA_97_U, E1BF, D1R, ONET_WA_16_D, ONET_WA_176_D, ONET_WA_12_D, D740_AL2, ONET_WA_172_D, -B1, D740R, ONET_WA_148_D, ONET_WA_140_U, D860AL, ONET_WA_93_D, ONET_WA_144_D, D810_AL2, ONET_WA_69_D, E115_F2, ONET_WA_61_U, ONET_WA_65_L, ONET_WA_116_L, D830_AL4, JOB_OBJ_NO, E575_F2, ONET_WA_112_D, D140R, ONET_WA_37_D, JOB_OPP_PURSUE, D175_AL2, ONET_WA_165_U, ONET_WA_33_D, B152_I2, ONET_WA_169_D, ONET_WA_8_D, RES_CONF_INFORMAL, D760AL, D8AL, D740_R2, B530I, ONET_WA_133_U, D660_R2, ONET_WA_4_D, ONET_WA_58_U, ONET_WA_161_D, ONET_WA_109_U, ONET_WA_86_D, ONET_WA_137_D, D4AL, JR_TALENT_ENC-MOTHER, E585BF, JR_TALENT_ENC-TEACH, JR_TALENT_ENC-FAMILY, D475_R2, E590_F2, ONET_WA_82_D, CJOB_GOVT, D350R, ONET_WA_50_U, B210I, D660_AL1, ONET_WA_54_D, O_NETNOW, ONET_WA_105_D, B117_I3, ONET_WA_101_D, D730_AL2, D475_AL2, ONET_WA_26_D, O*NETDISAB, D910AL, D660AL, ONET_WA_22_D, CAREER_PREP_NO, ONET_WI_NOW, D330_AL3, ONET_WA_79_U, ONET_WA_158_D, D870AL, JR_TALENT_ENC-AUNT, ONET_WA_154_D, D140AL, ONET_WA_122_U, JOB_TALENT_AWARE, E360BF, D475AL, ONET_WA_150_D, JR_TALENT_EDU, ONET_WA_75_D, ONET_WA_126_D, D350AL, S1I, ONET_WA_71_D, E570BF, ONET_WA_47_D, ONET_WA_175_U, D810AL, ONET_WA_43_D, E4BF, E110_F3, D720_R2, ONET_WA_19_D, ONET_WA_179_D, D640_R1, ONET_WA_15_D, D770AL, S110_I2, E570_F1, D770R, ONET_WA_92_U, ONET_WA_11_D, ONET_WA_68_U, ONET_WA_171_D, ONET_WA_96_D, ONET_WV_NOW, ONET_WA_147_D, RACE_WHITE, E115BF, ONET_WA_115_U, JZ_CURR_1, ONET_WA_143_D, ONET_WA_119_D, B310I, D720_AL2, E325BF, ONET_WA_64_D, D710AL, CURRENTLYEMPL, ONET_WA_32_U, ONET_WA_60_D, ONET_WA_111_D, ONET_WA_36_D, D470_R2, D920AL, B164_I2, B530_I2, ONET_WA_89_U, E410BF, ONET_WA_168_D, ONET_WA_85_U, ONET_WA_7_D, ONET_WA_164_D, D660R, D7AL, D150AL, ONET_WA_81_U, B5I, ONET_WA_3_D, ONET_WA_160_D, D950_AL3, D620R, ONET_WA_136_D, D3AL, S300I, ONET_IP_NOW, ONET_WA_132_D, ONET_WA_57_D, D620_R1, ONET_WA_108_D, ONET_WA_25_U, ICFNOW, D820AL, ONET_WA_53_D, ONET_WA_104_D, E550_F1, ONET_WA_29_D, E310BF, ONET_WA_100_D, D175AL, ONET_WA_157_U, RESOURCE_OPT, D640_AL1

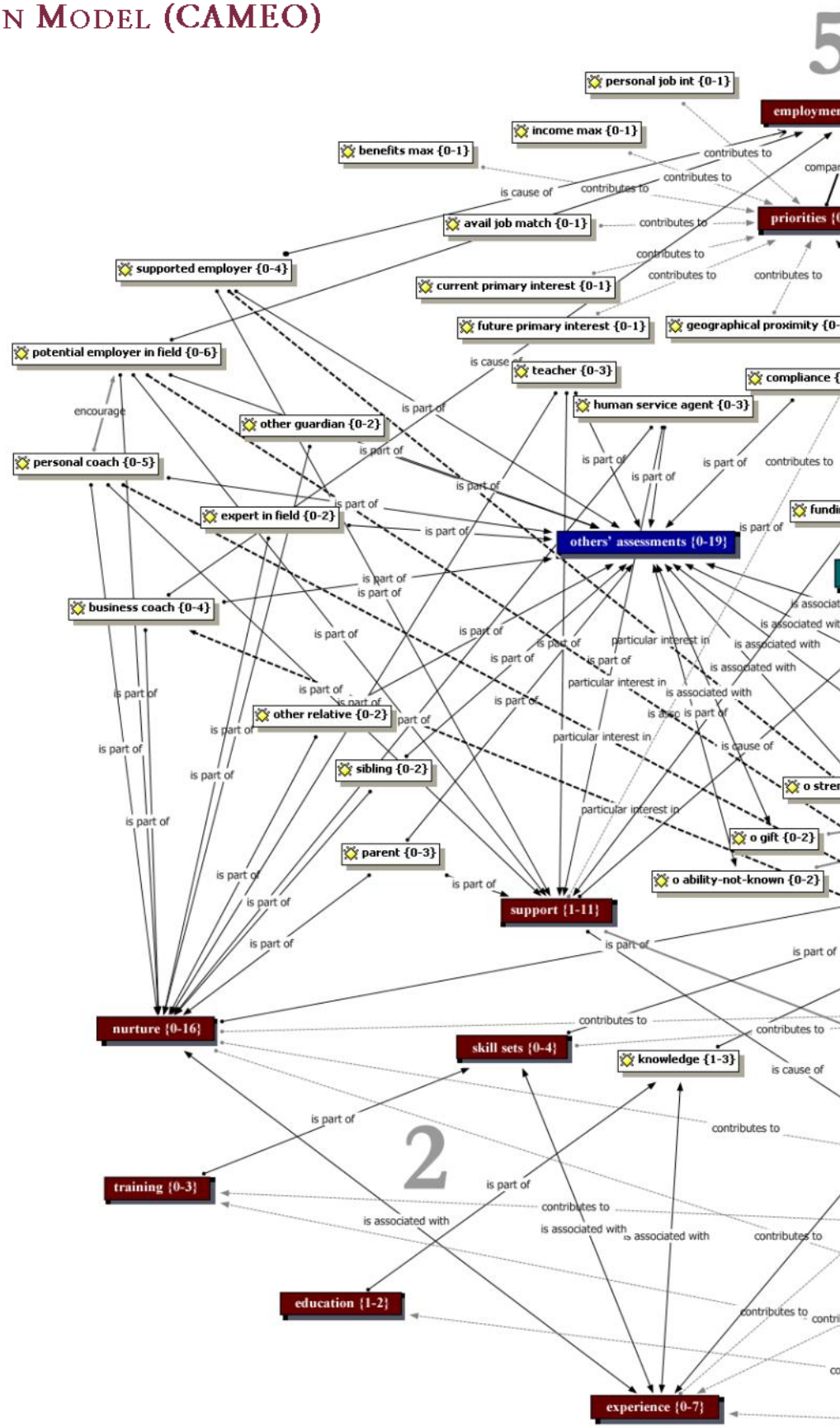
DATA COLLECTION THROUGH SIMPLE INTERFACE

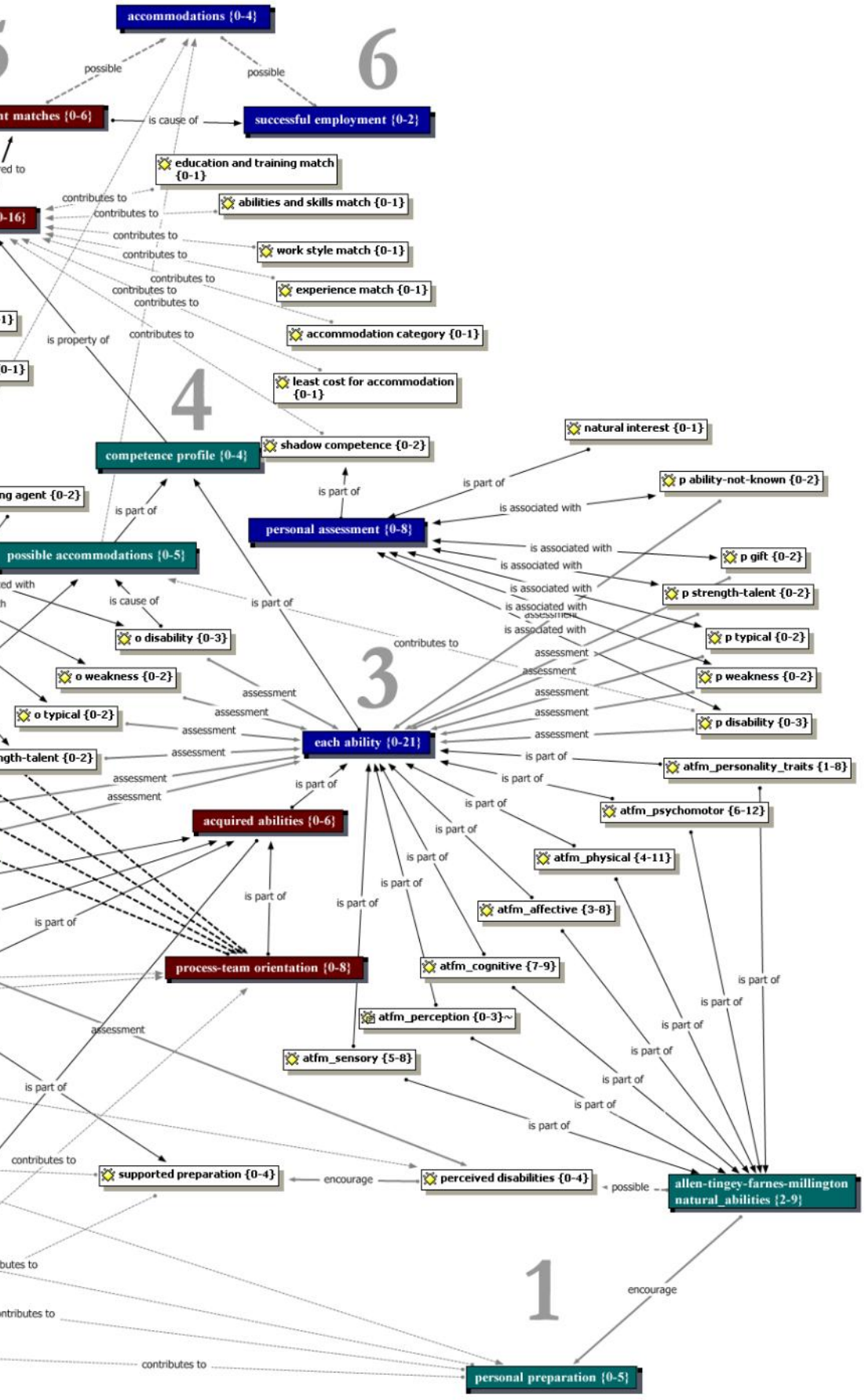
One advantage of the parsimonious approach to knowledge design using trees is that context is preserved within each session. As a result, as can be seen in the second and third figure on the prior page, individual users only face one set of questions at a time. A simple interface is thus possible, not dissimilar to the familiar "forward -backward" interface of popular electronic devices, such as videotape playback devices, digital video players, and music playback devices. This allows for broad usage of the system with little training requirement. The limited display requirements resulting from such an approach allow for a variety of technological delivery options, including cell phones, personal digital devices, and other personal electronic technology as well as computing platforms. In the process of the sessions in question, data can be collected and stored in individual profiles, providing for persistent stores of information.

COMPREHENSIVE SEMANTIC EVALUATION

Using the same tree-based model, large data stores can be evaluated based on research and practice standards based on priorities and conditions set by clients within ranged and limits defined by experts and authorities from many disciplines and areas of responsibility. As can be seen on the graphic on the last page, once data is collected in a tree-based session, it can be used by the system to automatically navigate through pre -set tree structures to evaluate conditions and provide timely feedback. Data previously stored in appropriate profiles can also be brought into the system to assist in such automatic evaluations. Results can immediately be sent using such a model to appropriate authorities and service providers, as well. In the case of this study, differential evaluations result from up to five combinations of fifteen options as outlined on page one of this document.

Multi-Phase Evaluation Model (CAMEO)

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natural interest {0-1}
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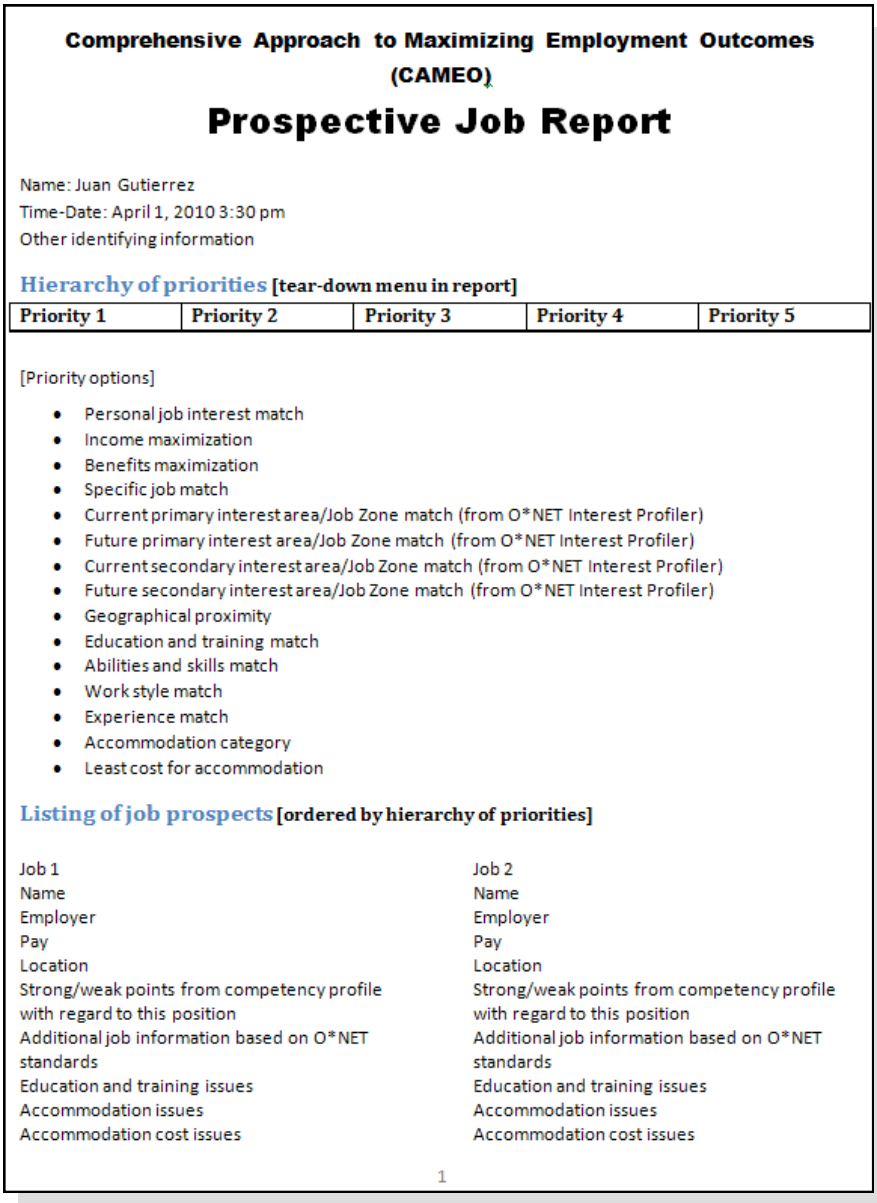
contributes to
personal preparation {0-5}



Comprehensive Approach to Maximizing Employment Outcomes (CAMEO)

Prospective Job Report

Name: Juan Gutierrez
Time-Date: April 1, 2010 3:30 pm
Other identifying information

Hierarchy of priorities [tear-down menu in report]

Priority 1	Priority 2	Priority 3	Priority 4	Priority 5

[Priority options]

- Personal job interest match
- Income maximization
- Benefits maximization
- Specific job match
- Current primary interest area/Job Zone match (from O*NET Interest Profiler)
- Future primary interest area/Job Zone match (from O*NET Interest Profiler)
- Current secondary interest area/Job Zone match (from O*NET Interest Profiler)
- Future secondary interest area/Job Zone match (from O*NET Interest Profiler)
- Geographical proximity
- Education and training match
- Abilities and skills match
- Work style match
- Experience match
- Accommodation category
- Least cost for accommodation

Listing of job prospects [ordered by hierarchy of priorities]

Job 1
Name
Employer
Pay
Location
Strong/weak points from competency profile with regard to this position
Additional job information based on O*NET standards
Education and training issues
Accommodation issues
Accommodation cost issues

Job 2
Name
Employer
Pay
Location
Strong/weak points from competency profile with regard to this position
Additional job information based on O*NET standards
Education and training issues
Accommodation issues
Accommodation cost issues

1

PRIORITY-BASED EMPLOYMENT MODELS

As can be seen in the mockup *Prospective Job Report* above, the CAMEO approach is designed to maximize a person's employment options by uncovering many possible scenarios. Grounded in an understanding of his or her abilities as represented by talents and gifts and a comprehensive view of that person's competence profile, the person in question is more likely to be able to achieve maximal results than when summary information based on incomplete information is used.

By the same token, the nature of the CAMEO approach is to be able to evaluate accommodation issues in the context of that person's opportunities made possibly by that person's talents, gifts, as well as his or her typical ability levels. *Universal Design* of the underlying logic and data models supports translational science in several ways. It makes all logic artifacts available to all collaborators. Simplicity in the models themselves allows designers to readily share their models. Simple user interfaces support broad usage, allowing participants to make use of inexpensive, readily available technology.

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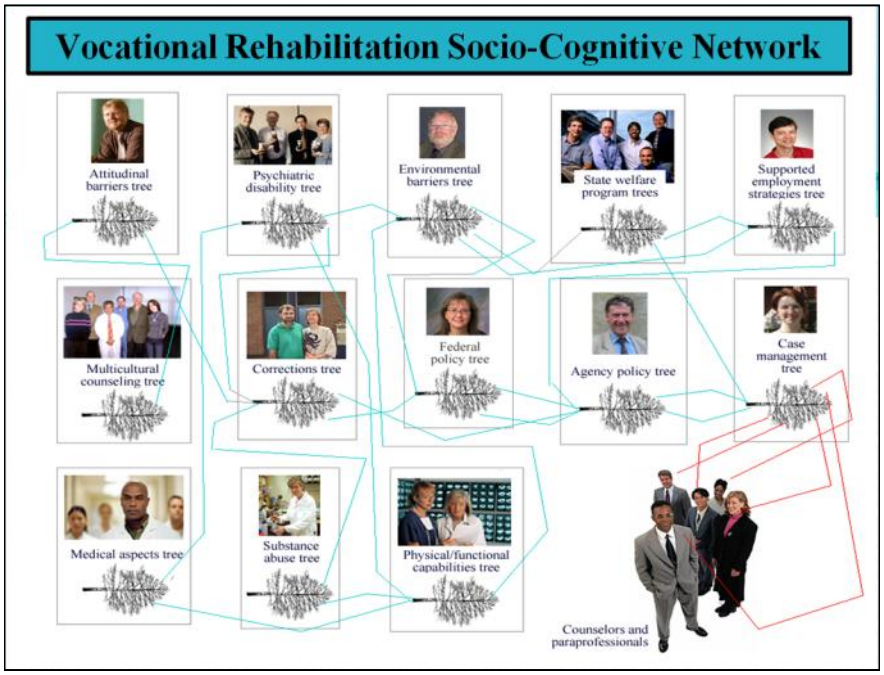

Implications for Vocational Rehabilitation

The use of Universal Design in knowledge representation allows for several breakthroughs in human services in general and vocational rehabilitation in particular. For one thing, it allows professionals in these professions, whether researchers, educators, or practitioners, to directly oversee and participate in the process of designing systems based on their respective areas of expertise and practice. The simplicity of the model belies an ability to support any and all subject area that can be described in textual, semantic ways. Furthermore, the approach provides for an associated user experience that requires little training — allowing for widespread usage by large segments of society using existing technologies and networks.

In additional to design and production advantages thus outlined, the model brings significant benefits to user communities that may not have the capacity to engage in design efforts, but that could benefit from such a system once it was in existence. This could include rural providers of vocational rehabilitation services as well as rehabilitation support services carried out in emerging and developing nations throughout the world. By providing a network to support complexity, such an approach could also encourage additional research, given its capacity for outreach and standardization.